A COMPARISON OF DIFFERENT MODALITIES OF TREATING SINGLE FRACTURES OF THE MANDIBLE

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CONTENTS

A COMPARISON OF THE TREATING MANDIBULAR FRACTURES AT THE DEPARTMENT OF MAXILLOFACIAL AND ORAL SURGERY, GROOTE SCHUUR HOSPITAL

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A research thesis submitted to the Faculty of Dentistry of the University of the Western Cape in partial fulfilment of the requirements for the degree of Magister Chirurgiae Dentium in the discipline of Maxillofacial and Oral Surgery.

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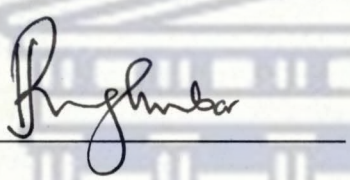
I. DECLARATION OF OWN WORK

I, **VIVESH RUGHUBAR** declare that this dissertation entitled "A comparison of different modalities of treating single fractures of the mandible" is my own work and all sources I have quoted have been indicated and acknowledged by means of references.

Signed: 

II. DEDICATION

This dissertation is dedicated to the loving memory of my late father, Maheshwadutt Rughubar, whose sacrifices, vision and love amongst other qualities has made my education possible.

To my dearest children, Carla and Mahesh, whose loving qualities they have inherited from their mother, Tina, and whose zest for life and thirst for knowledge inspires me.

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1. SUMMARY

Fractures of the mandible are the commonest of all facial fractures and accounts for the major part of the service provided by departments of Maxillofacial and Oral Surgery. These fractures are treated either by closed or open reduction and fixation. The latter is routinely performed under a general anaesthetic.

Due to the drastic reduction in the health budget of the Republic of South Africa, both at national and provincial levels, the need to assess both the efficiency and cost-effectiveness of the different modalities of treating similar conditions and determine which of the modalities provided the greatest saving to the department but at the same time not being detrimental to the patient.

A retrospective study analysing the records of patients treated at Groote Schuur Hospital for fractures of the mandible from January 1993 to December 1995 was carried out. Only patients with single mandibular fractures were included in the study.

The study showed that 199 patients fulfilled the criteria to be included in the study and that the majority of the patients were in the third and fourth decades of life with a male to female ratio of 4 : 1. Patients presented within 2 to 4 days for treatment and most were treated within 7 days. The angle of the mandible was the site of fracture in 75% of the patients with the same number of patients presenting with a tooth in the line of fracture. Pre-operative paraesthesia of the lower lip and chin was the most common presenting complication while more than 50% of patients had no complications.

Of the 199 patients, 123 (61%), were treated with intraosseous wires, 59 (30%) had plates placed and 17 (9%) were treated with a combination of wires and plates. The mean operating times ranged from 82 minutes (plating) to 105 minutes (plates/wires). The majority of patients treated with wires were placed into intermaxillary fixation (83%) for approximately 4 weeks whereas over 70% of those who were plated or had the combination procedure were not placed into intermaxillary fixation. The mean hospital stay for all patients was 4.5 days.

Transient paraesthesia of the inferior alveolar nerve was the most common post-operative complication recorded. This was higher in the group that were plated and those that had the combination procedure. Patients who had wires placed had the smallest percentage of complications (27%) while those treated with wires and plates had the highest (53%). The majority of patients presented at least twice to the out-patient department for their recall visits.

There were significant differences in the theatre times and cost of materials used. It cost approximately R150.00 more to treat a patient with wires than plates in an operating theatre. The cost of a single plate and four screws was calculated to be approximately R470.00 more than the cost of the length of wire used. Thus it may be calculated that the use of plates and screws cost approximately R320.00 more than using wires and this figure increases exponentially as the number of each unit increases.

The use of wires will thus result in significant savings financially to the department in the treatment of single fractures of the mandible. However it must be noted that not all fractures can be treated adequately with wires and that there are patients that may require the placement of plates and screws in the management of their fractures.

OPSOMMING

As 'n mens na alle gesigsfrakture kyk, kom frakture van die mandibula die mees algemeen voor en maak dit die groter meerderheid van die diens wat deur die department gelewer word uit. Hierdie frakture word behandel deur middel van of toe of 'n oop reduksie en fiksasie. Oop reduksies word roetien onder algeneem narkose gedoen.

As gevolg van die drastiese benoeing van die begroting vir Gesondheid, beide op 'n nasionale sowel as 'n provinsiale vlak, het die nodigheid om beide die effektiwieteit sowel as die koste - effektiwieteit van verskeie behandelings - metodes om dieselfde toestand te behandel, nodig geword, om sondoende vas te stel watter metode die grootste bespaning vir die department teweeg kan bring sonder om die pasient te benadeel. 'n Retrospektiewe studie, wat die rekords van pasiente wat behandel is vir kaakfrakture by Groote Schuur Hospitaal vanaf Januarie 1993 tot Desember 1995, was gedoen. Net die gevalle wat 'n enkele kaakfraktuur opgedoen het is by die studie ingesluit.

Die studie het getoon dat 199 pasiente ann die insluitings eienskappe voldoen het en dat die groter meerderheid van die pasiente in hul derde en vierde dekade van lewe was en dat die manlik tot vroulike verhouding 4 : 1 was. Pasiente het tussen 2 tot 4 dae presenteer vir behandeling en die meeste is binne 7 dae behandel. Die kaakhoek was in 75% van gevalle gebreek, met dieselfde persentasie gevalle met 'n tand in die fraktuur lyn. Parastesie van die onder lip en ken was die mees algeneme komplikasie by presentasie, alhouwel meer as 50% van die pasiente geen komplikasies gehad het nie.

In 123 pasiente was interosseuse bedrading die behandeling van keuse, terwyl 59 geplaat was en 17 pasiente deur middel van 'n kombinasie van drade en plate behandel is. Die gemiddelde operasietyd het gewissel vanaf 82 minute (plating) tot 105 minute (plate/drade). Die meerderheid van pasiente wat met drade behandel is, is 'n intermaksillere fiksasie geplaas (84%) vir ongeveer 4 weke terwyl meer as 70% van die gevalle wat geplaat is of 'n kombinasie behandeling ontvang het, nie in intermaksillere fiksasie geplaas is nie. Die gemiddelde verblyf in die hospitaal was 4 tot 5 dae. Verbygaande parastesie van die inferior alveolere senuwe was die algeeneste post - operatiewe komplikasie. Hierdie komplikasie was hoer in die groep wat geplaat was en die groep wat met 'n kombinasie behandel is. Pasiente wat met drade behandel is, het 'n kleiner komplikasie sypher (27%) gehad terwyl die wat met drade en plart behandel is, het die hoogste komplikasie sypher gehad het. Die meerkeerheid van pasiente het ten minste twee keer presenteer vir opvolg by die buite - pasiente kliniek. Daar was wesenlike verskille in die tater tye en in die koste van materiale wat gebruik is. Dit kos omtrent R150.00 meer om 'n pasient met drade te behandel vergelyke met plate in 'n teater. Die koste van 'n enkel plaat en vier skroewe was bereken om omtrent R470.00 meer as 'n lengte draad. Dit kan dus bereken word dat dit omtrent R320.00 meer sal kos om 'n patient met plate en skroewe te behandel, en hierdie sypher verhoog eksponentieel soos die aantal eeenhede vermeder.

Die gebruik van draad sal dus 'n wesnlike besparing te weeg bring in die department in die behandeling van frakture. Dit moet egter aanvaar word dat elke fraktuur nie noodwendig goed behandel kan word met drade nie en dat sekere frakture wel die gebruik van plate en skroewe sal benoedig.

2. INTRODUCTION

Mandibular fractures are common facial injuries, occurring twice as frequently as fractures of the bones of the midface. Only the nasal bones are fractured more often as the result of trauma to the face (*Olson et al 1982; Theriort et al 1987; Shepherd et al 1988; Dodson et al 1990; Lownie et al 1996*). In many oral and maxillofacial units, the treatment of fractures of the mandible form the major proportion of the services rendered.

Internationally it is accepted that there are two methods of treatment for fractures of the mandible, namely, closed and open reduction. Closed reductions are performed in dentate patients either under local or general anaesthesia. This method entails the placement of eyelet wires between or around teeth in both arches and then placing the patient into intermaxillary fixation. This is the method of choice when treating an undisplaced fracture of the mandible.

Open reductions are routinely performed under general anaesthesia. Depending upon whether the patient is dentate or not, eyelet wires are placed as mentioned above. The fracture site is then exposed, debrided and reduced by the placement of either wires or plates with screws or a combination of the two modalities of fixation (*Shiva 1954; Roberts 1964; Champy 1978; Theriot et al 1987; Moberg et al 1989; Hoffman et al 1990; Zachariades et al 1996*). These modalities are routinely employed in the Department of Maxillofacial and Oral Surgery at Groote Schuur Hospital and is in accordance with those commonly used throughout the world.

The recently adopted macro - economic plan of the Cental Government of this country has led to a decrease in the health budget. This reduction has particularly affected the Western Cape province and especially the academic health complexes within this province. There is thus a dire need to assess both the effectiveness and cost-effectiveness of modalities of treatment of similar conditions. The department of Maxillofacial and Oral Surgery of the Faculty of Dentistry of the University of the Western Cape resides physically in the aforementioned hospital, yet is the financial responsibility of the dental faculty.

As stated earlier, mandibular fractures are common and there are different modalities of treatment. The effectiveness and more important, considering the financial constraints, the cost-effectiveness of the treatment modalities needs to be investigated. International studies have shown that patients treated with plates and screws had fewer post-operative complications (*Kellman, 1984; Dobson et al, 1990; Hoffman, et al 1990; Brown et al, 1991; Morgan, 1992; El-Degini, 1993; Renton et al, 1996; Zachariades et al, 1996)* whereas the cost-effectiveness studies have shown that although the overall expense and operating time in patients treated with plates and screws is higher, in the long term it is more cost-effective as the patient enters the work force earlier *(Theriot et al, 1987; Thaller et al, 1990; El-Degini et al, 1993; Leach et al, 1995)*.

No studies have been conducted in South Africa to assess the effectiveness and cost-effectiveness of different modalities of treating single fractures of the mandible. This study will attempt to compare a variety of variables in the treatment of single fractures of the mandible using either rigid internal fixation or intraosseous wiring or both.

3. LITERATURE REVIEW

A review of the literature reveals that numerous studies have been conducted with regards the treatment of mandibular fractures using wires or plates and screws and the comparison between the two modalities. However, very little is mentioned about the costs incurred in performing either modality but mention is made of the cost-effectiveness to the patient.

Most studies report on the demographic characteristics of mandibular fractures, the time from injury to presentation and to surgery, the site of fracture, teeth in the line of fracture, pre-operative and post operative complications, duration of the surgical procedure, the implementation of intermaxillary fixation, the duration of hospital stay and the follow up period. These issues will be discussed in the review that follows along with the reasons for the different modalities of treatment.

3.1 Demographic characteristics of mandibular fractures

In the United States of America there was an increase in maxillofacial trauma during the 1960's (*Olson et al, 1982*). Shepherd and his co-workers reported that facial injuries were very common in patients presenting to hospitals in Great Britain with 89% of fractures involving the face in 1986. In a study of patients admitted to hospitals in the greater Johannesburg area with maxillofacial injuries, it was reported that 8% were children (*Bamjee et al, 1996*).

3.1.1 Age and Gender characteristics

Numerous studies have shown that fractures of the mandible occur most frequently in male patients below the age of 30 years with the majority in the third decade of life *(Hagan et al, 1961; Hulke et al, 1964; James et al, 1981; Olson et al, 1982; Winstanley, 1984; Shepherd et al, 1988; Mwaniki et al, 1990; Adi et al, 1990; Lownie et al, 1996).*

A number of studies have shown that the male to female ratio was approximately 4 : 1 in patients below 30 years of age *(Hagan et al, 1961; Hulke et al, 1964; James et al, 1981; Olson et al, 1982; Winstanley, 1984; Shepherd et al, 1988; Mwaniki et al, 1990; Adi et al, 1990; Lownie et al, 1996).* Adi et al (1990) reported a male to female ratio 3:1 in a study carried out in Dundee, Scotland. Mwaniki (1990) however reported a ratio of 8.4:1 in Nairobi, Kenya. The ratio of males to females in a study on children in the Republic of South Africa was the same as for adults, that is 4 : 1 *(Bamjee et al, 1996).*

In patients who received gun shot injuries to the maxillofacial region, the mean age was 30 years and the male to female ratio was 8.6 : 1.4 *(Kassan, 1997).*

3.1.2 Aetiology

Studies assessing the aetiology of facial trauma report various causes depending on where the study was carried out.

Some studies report that motor vehicle accidents account for the majority of facial trauma *(Olson et al, 1982; Widmark et al, 1991)* whereas others cite inter personal violence as the commonest cause *(James et al, 1981; Johansson et al, 1981; Frost et al, 1983; Winstanley, 1984; Shepherd et al, 1988; Mwaniki et al, 1990; Adi et al, 1990; Moore et al, 1990; Telfer et al, 1991; Rix et al, 1991; Smith et al, 1991; Lownie et al, 1996)*.

In a study carried out in the Cape Metropolitan area *(Medical Research Council, 1990)* treatment at both the public and private sectors was assessed. Injuries to the mandible accounted for 0.34% of the total sample of 248 843 injuries. These included both fatal and non-fatal injuries. The male to female ratio was 3.5 : 1.

The table below illustrates the cause and mechanism of injury.

Table 1: Cause and mechanism of mandibular injuries:

CAUSE/ MECHANISM OF INJURY	%
Violence	70.8
Sharp instrument	21.8
Blunt object	39.1
Fist	29.3
Fall	9.8
Traffic	22.3
Driver	69.0
Pedestrian	31.0
Sport	6.9
Fist	100.0

3.1.2.1 Spouse / women abuse

Spouse abuse was noted in the older age group - 57% of those over the age of 30 years. In patients who had sustained a fall, 50% were females with no history of syncope, vertigo or physical handicaps and may be attributed to spouse abuse (*Olson et al 1982*). In South Africa it has been reported that 2% of women are the victims of violence (Steenkamp et al, 1996).

3.1.2.2 Interpersonal violence

Interpersonal violence is often found to be associated with a number of other factors, the most common being alcohol consumption (*Canaille et al, 1985; Summer et al, 1987; Shepherd, 1990; Rix et al, 1991; Widmark et al, 1991; Telfer et al, 1991*). It may not be the consumption per say that results in violence but the circumstances and environment where violence occurs may be more important. Defence activity is increased by alcohol consumption so that violence is more likely to be the end result (*Shepherd, 1990*). Telfer et al (1991) noted a steady increase in the number of cases of inter personal violence with a decrease in the number of fractures resulting from motor vehicle accidents.

The study on gun shot injuries carried out in the Western Cape region of the Republic of South Africa showed that the number of injuries increased exponentially from 1980 to 1995 with 65% of the injuries occurring after 1990 *(Kassan, 1997)*.

Unemployment is also associated with an increase in maxillofacial injuries (*Summer et al, 1987; Telfer et al, 1991*).

Other factors influencing inter-personal violence as reported by Summer and his co-workers (1987) are:

- disintegration of the family unit due to death, separation or divorce (with some cases a history of alcohol abuse is also noted)
- single, separated or divorced individuals
- health complications
- housing problems
- illiteracy
- recent exposure to violence
- stress

In a study of maxillofacial injuries in children, it was found that inter personal violence was the major cause of injury *(Bamjee et al, 1996)*.

3.2 Time from injury to presentation and surgery

The time that elapses between the person being injured and presenting to an institution for treatment varies depending on where the study is carried out. This is also true for the period of time that a patient has to wait prior to be treated.

Reports in the literature is scanty with regards to the time elapsed between injury and presentation to hospital. Most studies refer only to the time from injury to surgery which includes the time from injury to presentation *(Theriot et al, 1987; Hoffman et al, 1990; Morgan et al, 1992)*. Iizuka and Lindqvist (1993) reported that 38.1% of patients present to hospital within 24 hours of being injured and 25.6% between 1 and 2 days after injury. The majority of their patients presented within 4 days of injury.

Theriot et al (1987) reported an average time from injury to surgery of 2.1 days in patients in whom wires were used and 2.7 days in those who were plated. This is much lower than 5.4 days for both groups as reported by Hoffman et al (1990) and that of Morgan et al (1992) where the time elapsed for patients with intraosseous wiring was 6 days and those plated was 4 days.

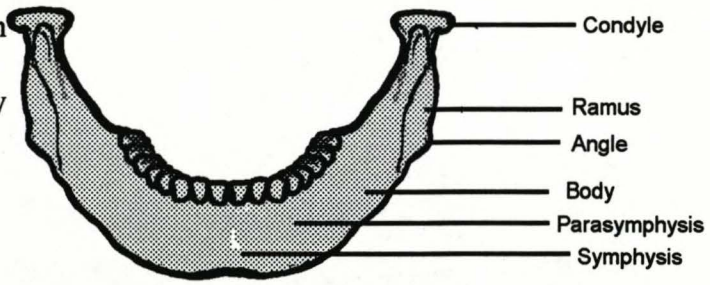
Leach et al (1995) reported an average of 1.5 days for wiring patients and 2 days for those with plates.

Table 2: Time from injury to surgery in days

	Wiring	**Plating**
Therioet et al (1987)	2.1	2.7
Hoffman et al (1990)	5.4	5.4
Morgan et al (1992)	6	4
Leach et al (1995)	1.5	2

3.3 Site of fracture

Fractures of the mandible can occur at any anatomical site depending on the direction and force of the injury (Mwaniki et al, 1990).



The most common site of fracture of the mandible caused by motor vehicle accidents are the condyles and subcondylar areas, followed by the angle, symphysis and parasymphysis and the least common site is the body of the mandible (*James et al, 1981; Olson et al, 1982*).

Head injuries were the most common associated injury.

In patients who sustained fractures following inter personal violence, the angle was the most common site (*Johansson et al, 1988; Frost et al, 1983; Winstanley, 1984; Shepherd et al, 1988; Mwaniki et al, 1990; Adi et al, 1990; Rix et al, 1991; Smith et al, 1991; Telfer et al, 1991; Lownie et al, 1996*). The body of the mandible was the most common site in single fractures whereas the angle was more common in multiple fractures. There were more left sided fractures than right and this could be related to the fact that more people are right handed (Mwaniki, 1990).

In children, the most common fracture site was the body of the mandible*(Bamjee et al, 1996)*.

3.4 Teeth in the line of fracture

In dentate and partially dentate patients who sustain fractures of the mandible, one or more teeth may be involved in the line of fracture and this may determine the modality of treatment used to treat the fracture

James and his co-workers (1981) reported that 39% of teeth in the line of fracture were extracted at the time of the operation. The criteria used to evaluate which teeth to extract was 4+ mobility, tooth root fracture, apical pathology, and the need of the tooth for reduction and fixation. Renton et al (1996) reported similar findings.

3.5 Pre-operative complications

At the time of presentation the patient may report symptoms that may determine the modality of treatment used.

Fracture of the mandible may cause injury to the inferior alveolar nerve, but considerable displacement of fractures through the inferior alveolar canal can occur without altering the sensation of the lip (Winstanley, 1984). Recovery rate of the altered sensation is good with only 8% of dentate patients reporting no recovery post-operatively and 11% of edentulous patients reporting partial recovery of sensation (Winstanley, 1984).

Pre-operative infections were the only complications recorded by James and his co-workers (1981). Tu et al (1985) reported a 5% incidence of pre-operative infections. Widmark et al (1991) reported pre-operative sensitivity disturbances in 50% of their patients.

3.6 Duration of operation

The time that is required in the operating theatre to treat a patient with a fracture of the mandible is directly related to the anaesthetic time, the number of fractures to be reduced and fixed, the displacement of the fractures and the experience of the surgeon.

Theriot et al (1987) reported that the average operating time for the placement of intraosseous wires was 108 minutes and for placing a plate was 132 minutes. Thaller et al (1990) reported longer times, i.e. 162 minutes and 184 minutes respectively. Similar results were reported by Leach et al (1995).

3.7 Intermaxillary fixation

In dentate and partially dentate patients intermaxillary fixation has been employed in the intra-operative and post operative periods.

Freihofer and Sailer (1973) recommended that intermaxillary fixation for 6 weeks is sufficient in all cases of fractures of the mandible and a reduction of fixation to 4 weeks in uncomplicated cases with intraosseous wiring. Niederdellman et al (1986) proposed the use of intermaxillary fixation for 1 week when treating bilateral fractures of the mandible with lag screws. Champy et al (1978) suggest that there is no need for intermaxillary fixation when plates are placed and this is supported by other authors (Levine et al, 1980; Souyris et al, 1980; Frost et al, 1981; Cawood et al, 1985; Wald et al, 1986; Moore et al, 1990; Levy et al, 1991; Smith et al, 1991; Ellis, 1993; Hayter et al, 1993).

Theriot and his co-workers (1987) used intermaxillary fixation for 4 - 7 days in patients who had plates placed to ensure no breakdown of the surgical wound and 6 weeks in patients with intraosseous wires. Similar reports were made by others (Dobson et al, 1990; Hoffman et al, 1990; Thaller et al, 1990; Morgan et al, 1992; Renton et al, 1996; Zachariades et al, 1996).

3.8 Duration of hospital stay

The duration of hospital stay depends largely on the type of fracture, extent of injury and type of fixation, that is, wiring, plating or both.

There was no significant difference in the number of days that patients stayed in hospital in a study by Brown et al (1991) where patients who had intraosseous wiring stayed for 3.6 days and those who had plates placed stayed 3.1 days on the average. El-Degwi et al (1993) reported longer stays of 6.3 days for intraosseous wiring and 8.6 days for plating.

3.9 Post-operative complications

There have been numerous post-operative complications that have been described and reported in the English language literature.

Freihofer and Sailer (1973) reported on post - operative complications associated with intraosseous wiring and noted that 3% of patients had disturbances in healing, 3% had malunions, 1% had other healing complications and 9% had minor local infections at the surgical site.

James et al (1981) reported on the treatment of fractures in 177 patients using different treatment modalities. Delayed union was found in 0.5% of patients, non - union in 0.15%, malunion in 0.15% and an infection rate of 9%. Paraesthesia of the lip was reported in 3% of patients by Winstanley (1984).

When lag screws were used, Niederdellman et al (1986) reported that 4% of patients had malunions, 2% occlusal disturbances, 6% sensory disturbances and 4% infections.

When plating of the mandible is considered, Battersby (1967) reported a 10% incidence of infection, 0.5% permanent paraesthesia, 0.5% keloid formation, and 40% transient paraesthesia. Champy et al (1978) reported a 3.8% infection rate, 0.5% malunions and 0.5% non - unions. Similar results have been reported by other authors (Souyris et al, 1980; Frost et al, 1981; Cawood, 1985; Wald et al, 1988; Moore et al, 1990; Levy et al, 1991; Rix et al, 1991; Smith, 1991; Widmark et al, 1991; Hayter et al, 1993).

The use of compression plates was described by Levine and his co-workers (1981) who reported discomfort at the site of the plate, which required removal after bone healing and soft tissue infections and Strelzow et al (1982) reported plate exposure and mental nerve sensory disturbances as additional complications. These were also reported by other authors (Tu et al, 1985; Ardavy, 1989; Peled et al, 1989; Luhr et al, 1996).

When comparing intraosseous wiring and plating, Kellman (1984) reported non - union in 17% and malunion in 16% of patients treated with intraosseous wiring, while those who had plates had no complications. Similar results were reported by Theriot et al (1982) and Thaller et al (1990). Hoffman et al (1990) reported major complications (non - union and malunion) in 8% of patients with plates and 14% of patients with intraosseous wires. In the minor complication group (infection, pain, VII nerve palsy), there was a 17% incidence in the plated group as compared with 9% in the patients with intraosseous wires. Morgan et al (1992) reporting on a small sample showed a higher incidence of malunion, non - union and infection in the non - plated group than in the plated group.

El-Degwi et al (1993) reported an infection rate of 21.3% for plating and 9.6% for intraosseous wiring. Overall complication rates for plating was 38.7% and intraosseous wiring was 22.3%. Renton et al (1996) reported similar incidence of complications in both plated and intraosseous wiring patients. Zacariades et al (1996) reported infection rates of 13% and 3% with intraosseous wiring and plating respectively.

Table 3: Post-operative complication rates

Author	Malunion	Non-union	Delayed union	Infection	Paraesthesia
Battersby (1967)				10	40.5
Freihofer et al (1973)	3			9	
Champy et al (1978)	0.5	0.5		3.8	
James et al (1981)	0.15	0.15	0.5	9	
Kellman (1984)	16	17			
El-Degwi (1993)				21.3	
Zacariades et al (1996)				13	

3.10 Period of follow-up

The follow-up period depends upon the modality of treatment and whether the patient is placed into intermaxillary fixation or not.

El-Degwi et al (1993) reported a 6 week follow - up period. This is in keeping with placing the patient into intermaxillary fixation for a period of 6 weeks.

3.11 Number of follow-up visits

The number of follow-up visits depends on whether the patient is placed into intermaxillary fixation and if there are any post-operative complications.

El-Degwi et al (1993) reported that the mean number of follow - up visits for patients with plates was 5.4 compared with 4.8 for those with intraosseous wires.

3.12 Costs of treatment

The cost of treatment may be the costs incurred by the institution providing the treatment or may be the cost-effectiveness to the patient.

Treating a patient with a fractured mandible with plates and screws under general anaesthesia and discharging the patient after 2 days cost 733 pounds sterling in Britain. This included removal of the plate after healing was completed (Lowry, 1990). A hospital stay of 7.3 days for patients who had plates placed compared to 4.3 days for the non-plated patients increases the cost of treatment (Hoffman et al, 1990). The costs of the plates and screws are billed to the hospital and these cost between 40 to 80 and 15 American dollars respectively (Thaller et al, 1990).

Brown et al (1991) reported that the cost of the plates ans screws was 7.5% of the total cost of treating the patient. Furthermore, the number of outpatient visits were reduced as there was no need to adjust intermaxillary fixation wires.

Plates were expensive and required a longer operating time but they were of benefit to the patients as they could use their mouths normally post-operatively and return to work sooner (Zachariades et al, 1996)

3.13 Treatment of mandibular fractures

The result aimed for in the treatment of fractures of the mandible is restoration of function, occlusion of the teeth (or dentures) and normal appearance of the face. Certain basic surgical principles must be followed to ensure successful management and these include:

- adequate reduction of the segments
- adequate immobilisation of the fragments and
- maintenance of the fragments in the immobilized position for a sufficient period of time to allow for healing (*Shiva, 1954; Winstanley, 1984; Tu et al, 1985*).

The ideal reduction is when normal continuity of the mandible is re-established and the fragments are in their normal anatomical position and if the fracture involves an area of the mandible containing teeth, that the teeth are in occlusion. In some instances this is not possible and it is

good surgical judgment to accept minor discrepancies (*Shiva, 1954*). These minor discrepancies will be corrected during the healing process with apposition and resorption (remodelling).

Adequate reduction can be defined as "reduction that will ensure normal function of the jaws and normal appearance of the face when healing is complete" (*Shiva, 1954*). Successful healing is dependent upon immobilization. Although untreated fractures occasionally unite, the majority form a non-union or a malunion. Adequate immobilization does not mean complete immobilization since slight movements of the fracture stimulates the formation of granulation tissue leading to bone healing. The movement should not be detectable clinically.

Inflammation, age, systemic diseases and nutrition influence the rate of fracture healing (*Shiva, 1954; Winstanley, 1984*).

3.13.1 Closed reduction of mandibular fractures

In a dentate patient who has teeth on both the distal and proximal fragments, it may be possible to treat such a patient by means of a closed reduction with eyelet wires and intermaxillary fixation for a period of six weeks. However, it must be noted that adequate reduction must be obtained. Such a procedure can be performed using either local or general anaesthesia.

3.13.2 Open reduction of mandibular fractures

Open reduction and fixation of mandibular fractures are usually carried out under a general anaesthetic under aseptic conditions.

Some of the indications for an open reduction are:

- fractures distal to the last tooth
- edentulous mandibles
- when the maxilla is edentulous
- in patients who present late for treatment
- associated facial bone fractures
- to treat non-unions and malunions
- following infections
- fractures in children
- complex fractures
- when pseudo arthritic symptoms appear after treatment (*Shiva, 1954; Roberts, 1964; Freihofer et al, 1973*).

In the Department of Maxillofacial and Oral Surgery at Groote Schuur Hospital, patients with associated head injuries, respiratory problems and patients requiring further surgical procedures are treated with open reduction and fixation procedures. Open reduction may be performed either intra- or extraorally.

The modalities of treatment employed at the above mentioned institution are either intraosseous wiring or bone plates and screws or a combination of the two methods.

Figure 1: Intraosseous wiring using two wires. One wire is in the form of a figure of 8

Figure 2: Intraosseous wiring and plating at the angle of the mandible

Figure 3: Two plates placed in the region of the mental nerve

Figure 4: Two plates at the angle and one in the body of the mandible

3.13.2.1 Intraosseous wiring

The use of the direct intraosseous wiring technique was first described by Movel-Lavallae in 1861 when it was used in conjunction with splints. In 1933 Kazanjian also proposed this method (*Friehofer et al, 1973*). In 1954 Shiva and Bradley et al described in detail the method of placement of the intraosseous wires. That year, Obwergeser introduced the method in Zurich.

Friehofer and Sailer (1973) reported a complication rate of 7% in 178 wiring sites i.e. 12 sites of which four required reoperation. The main complications were occlusal abnormalities and delayed union. They concluded that:

- the intraoral transosseous wiring technique was a proven method of treatment but had a shortcoming in the treatment of middle segment fractures.
- post - operative infection was small although the intraoral approach was used exclusively.
- the final results were as good as using bone plates.
- treatment of fractures of edentulous, atrophic mandibles were subject to high complication rates.
- surgery should be done as early as possible following the fracture.
- intermaxillary fixation for six weeks is sufficient in all cases but may be reduced to four weeks in uncomplicated cases.

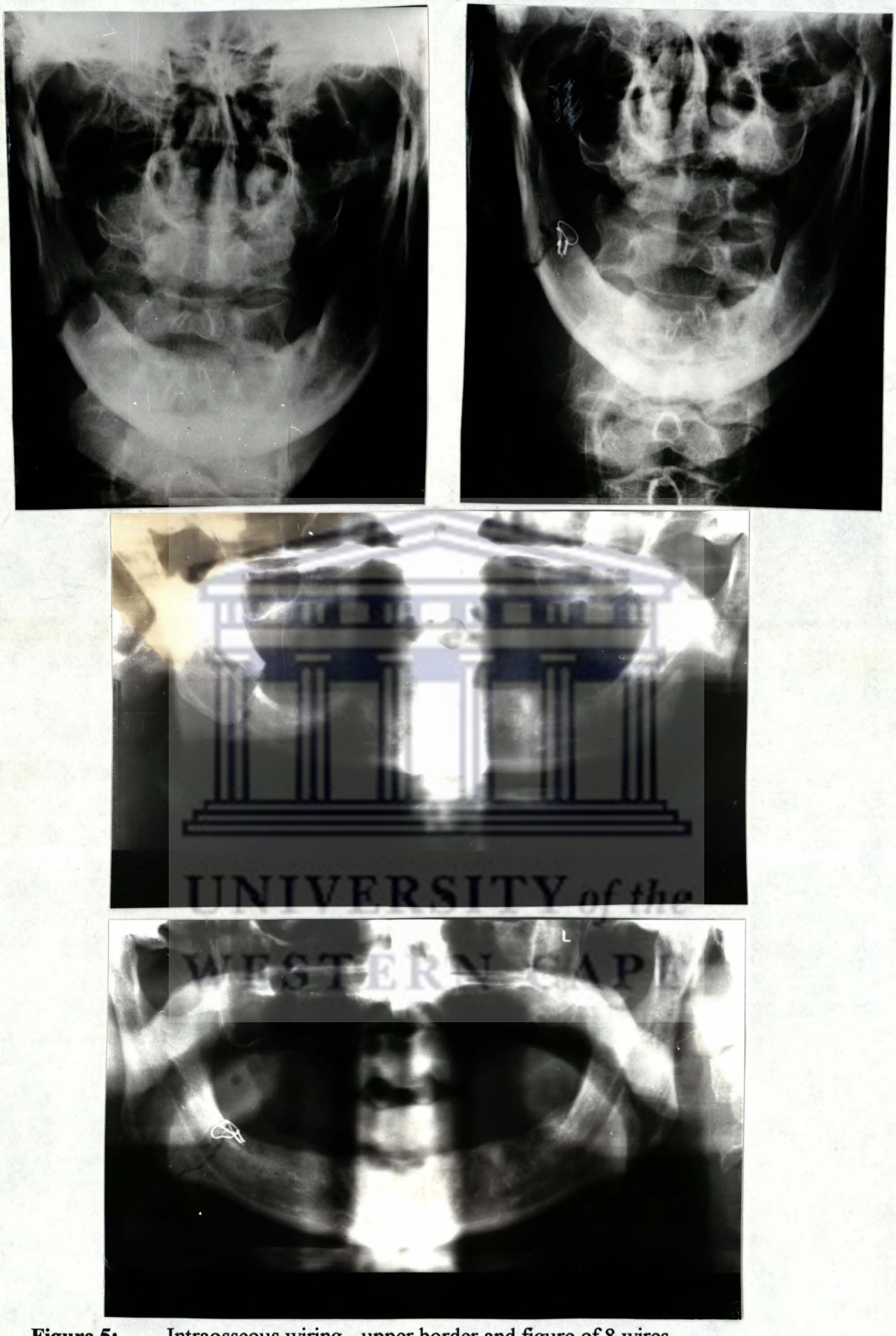


Figure 5: Intraosseous wiring - upper border and figure of 8 wires

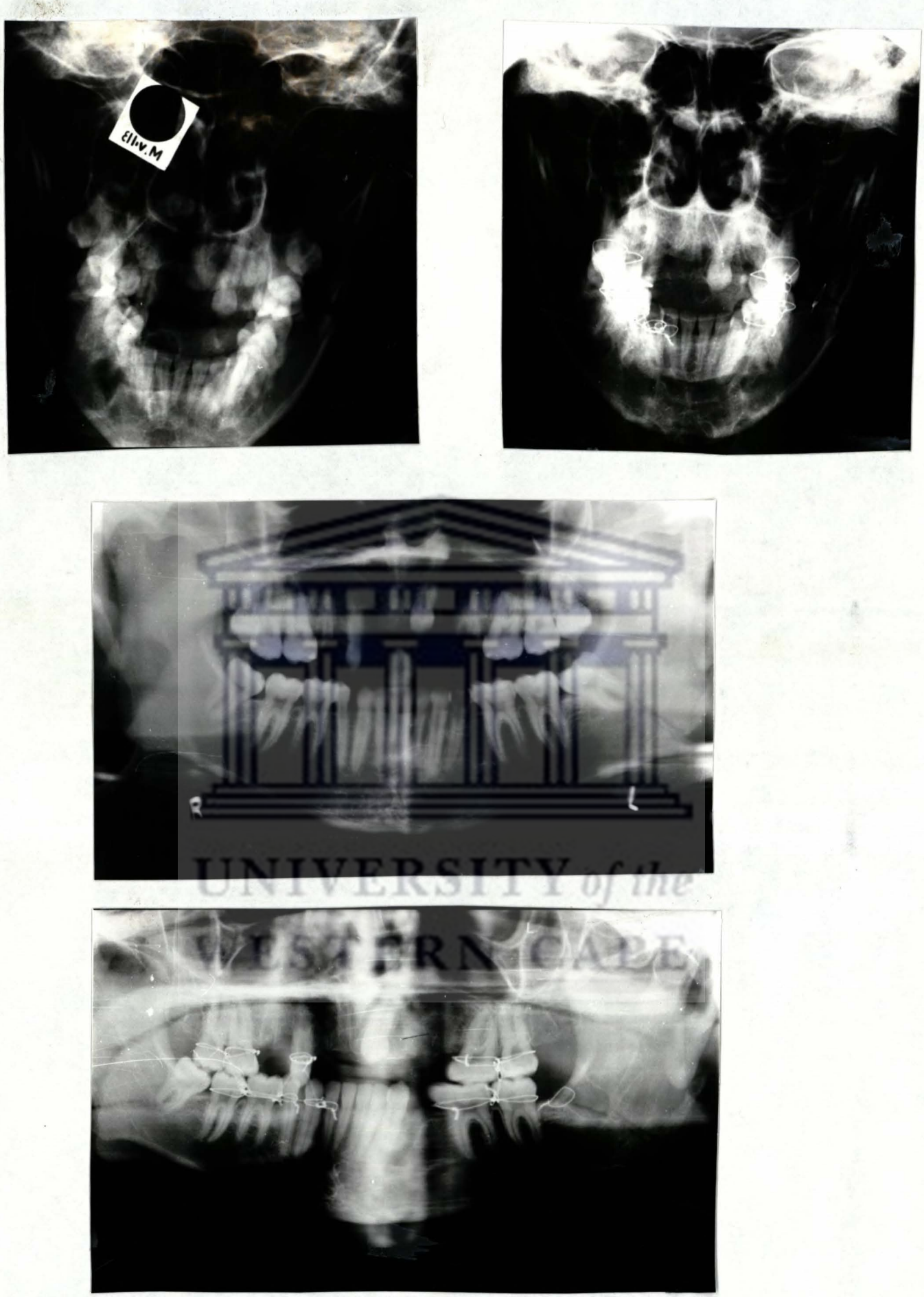


Figure 6: Intraosseous wiring and intermaxillary fixation

3.13.2.2 Bone plates and screws

The use of bone plates and screws for the treatment of mandibular fractures has been widely described in the English literature. Niederdellmann and Shetty (1987) described the use of a solitary lag screw in the treatment of fractures of the angle of the mandible. Their treatment met with the principles of rigid internal fixation and removed the need for intermaxillary fixation. In a series of 50 patients, two (4%) developed an infection, three (6%) had persistent sensory disturbances, one (2%) had occlusal disturbances and two (4%) had malpositions of the fragments on postoperative radiographs. This method is technically difficult given that other modalities of treatment are available.

The first reference to the use of plates in jaw surgery was made by Winter in 1945. Since then it has been widely used in the United States of America but not in the United Kingdom until 1964. Thoma advocated the use of plates in 1963 (*Battersby, 1967*). In 1964 Roberts described the use of plates and screws in the treatment of fractures of the mandible. Vitallium was the first material used by Venables in orthopaedic surgery in 1932.

Indications and advantages for plating of the mandible include:

- no need for intermaxillary fixation and hence movement of the jaw after surgery and in edentulous mandibles, in children and where airway management is a problem.
- in associated comminuted fractures of the coronoid and zygomatic complex to avoid ankylosis.
- in mentally handicapped patients, severe epileptics and patients with head injuries.
- when there is loss of continuity of bone eg. in the removal of a tumour.

- for precise reduction and fixation especially in the elderly with atrophic mandibles.
- when there is overriding of the fragments (oblique fractures).
- following an ostectomy or osteotomy
- operating time is shortened.
- earlier feeding with solid and semi-solid foods.
- bilateral fractures of the body or symphysis of the mandible.

(*Roberts 1964; Battersby 1967; Michelet 1973; Champy 1978; Bekker 1974; Cawood 1985; Tu 1985; Hayter 1993*).

Some of the disadvantages are:

- a general anaesthetic
- damage to the mandibular branch of the facial nerve via an extraoral approach

  damage to the inferior alveolar nerve if the plates are not positioned properly
- may cause infections
- may interfere with placement of prosthesis

(*Roberts 1964; Battersby 1967; Frost 1983; Cawood 1988*)

The plates used by Roberts and Battersby were manufactured from a chrome-cobalt-molybdenum alloy. In 1973 Michelet et al described the intraoral and extraoral approaches for placement of plates. Champy et al described a modified method in 1978. This involved the use of a troacher via a buccal stab incision. Both methods did not use either compression or intermaxillary fixation. They reported a complication rate of 3 % in 183 cases treated. Infection was noted in 0.5%, malunion in 0.5%, delayed union in 0.5% and occlusal discrepancies (treated by grinding) in 4.8% of the cases. Studies by other authors describe similar complication rates (*Souyris et al, 1980;*

Cawood, 1985; Wald et al, 1988; Moore et al, 1990; Levy et al, 1991; Rix et al, 1991; Widmark et al, 1991; Smith, 1991; Hayter et al, 1993).

Frost et al (1983) evaluated the use of metacarpal bone plates in the treatment of mandibular fractures and reported a complication rate of 17.7% (17 of 96 plates). Infection was cited as the major cause of failure along with operator error. Cawood (1985) identified two other complications, namely, sulcus loss and wound dehiscence. The former affected 16% of cases mainly in the symphysial area and the latter affected 12% of the cases in the posterior region. Widmark et al (1991) reported a high incidence of sensory disturbances (15 of 47 patients).

Smith (1991) contested Champy's 1986 recommendation regarding postoperative complications which were:

- Osteosynthesis should be carried out within 12 hours of injury and old, infected fractures should preferably have compression plate immobilization or intermaxillary fixation.
- Careful pre and postoperative oral hygiene.
- Antibiotics only for compound and delayed fractures.
- The incision line should lie 4-5 mm below the level of the attached gingiva, that is, in the alveolar mucosa.
- Haematomas can be avoided by using suction drains and elastic bandages.
- Large discrepancies in the occlusion require a second operation while small discrepancies can be overcome by occlusal grinding.

Smith contended that performing surgery within 12 hours of injury was impractical as patients usually presented outside of the normal working hours, often intoxicated with alcohol and may have an associated head injury. Preoperative oral hygiene was difficult and uncomfortable for a patient with a mobile fracture. Withholding of antibiotics was unnecessary. The incision line should be modified and he recommended a gingival margin incision for the treatment of angle and body fractures.

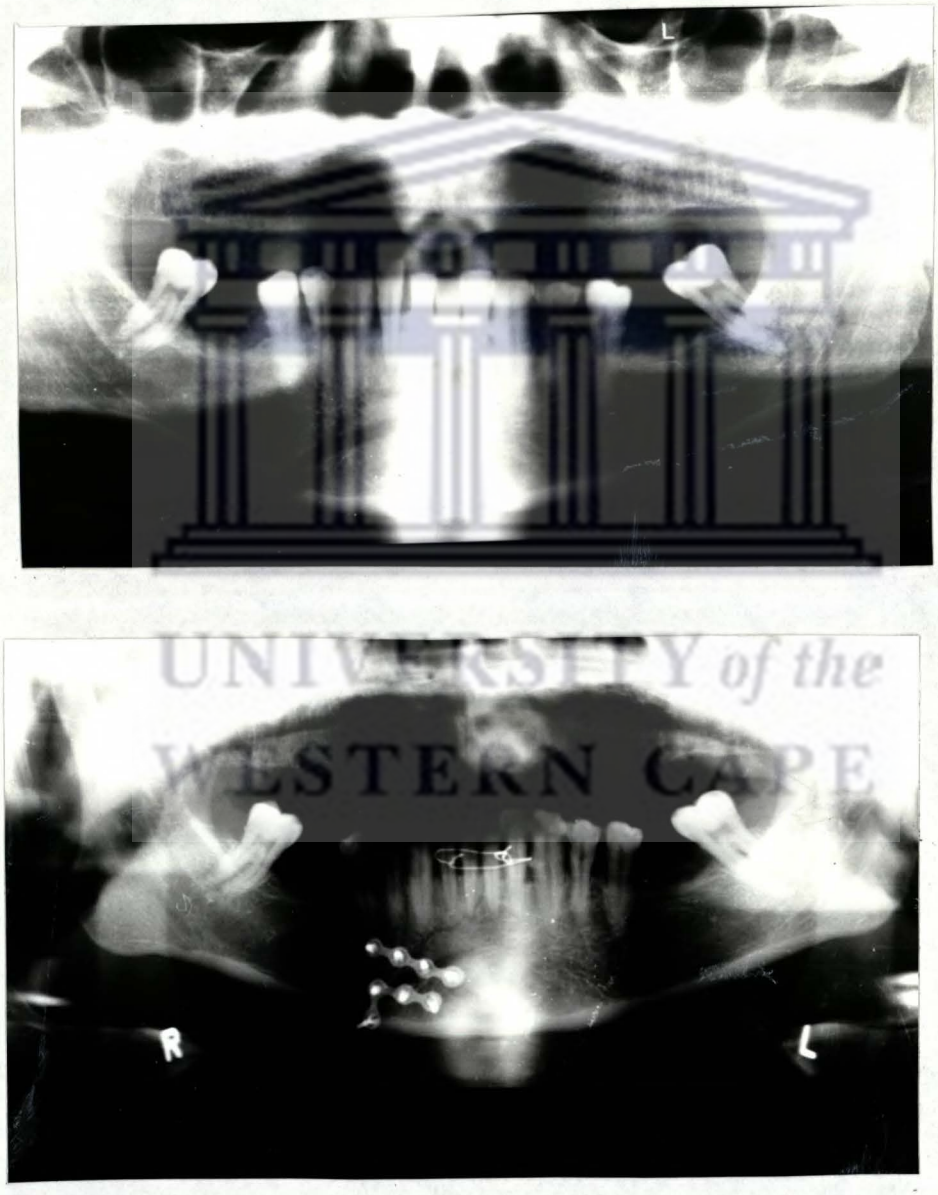


Figure 7: Plating of a parasymphysial fracture

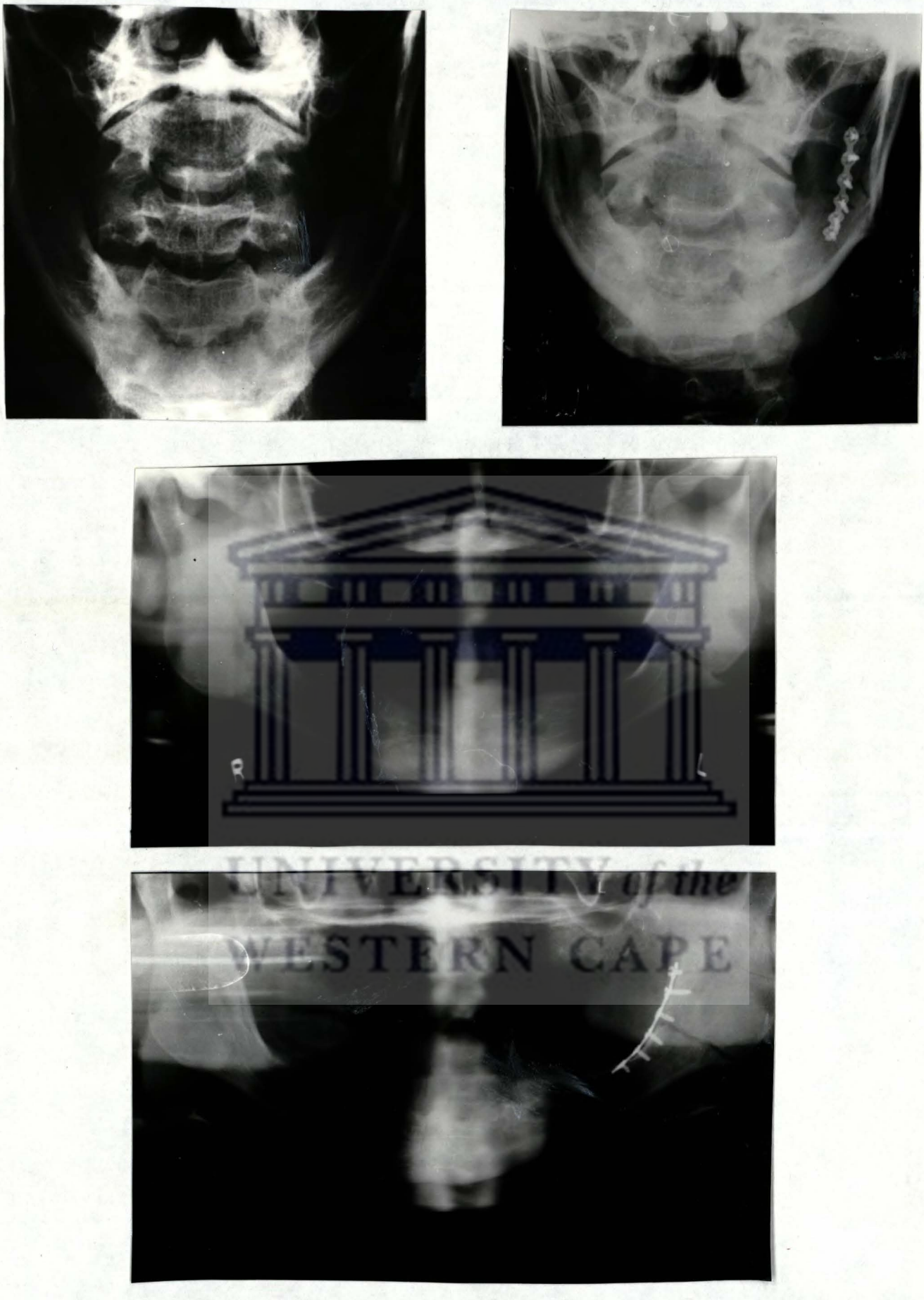


Figure 8: Plating of the angle of the mandible

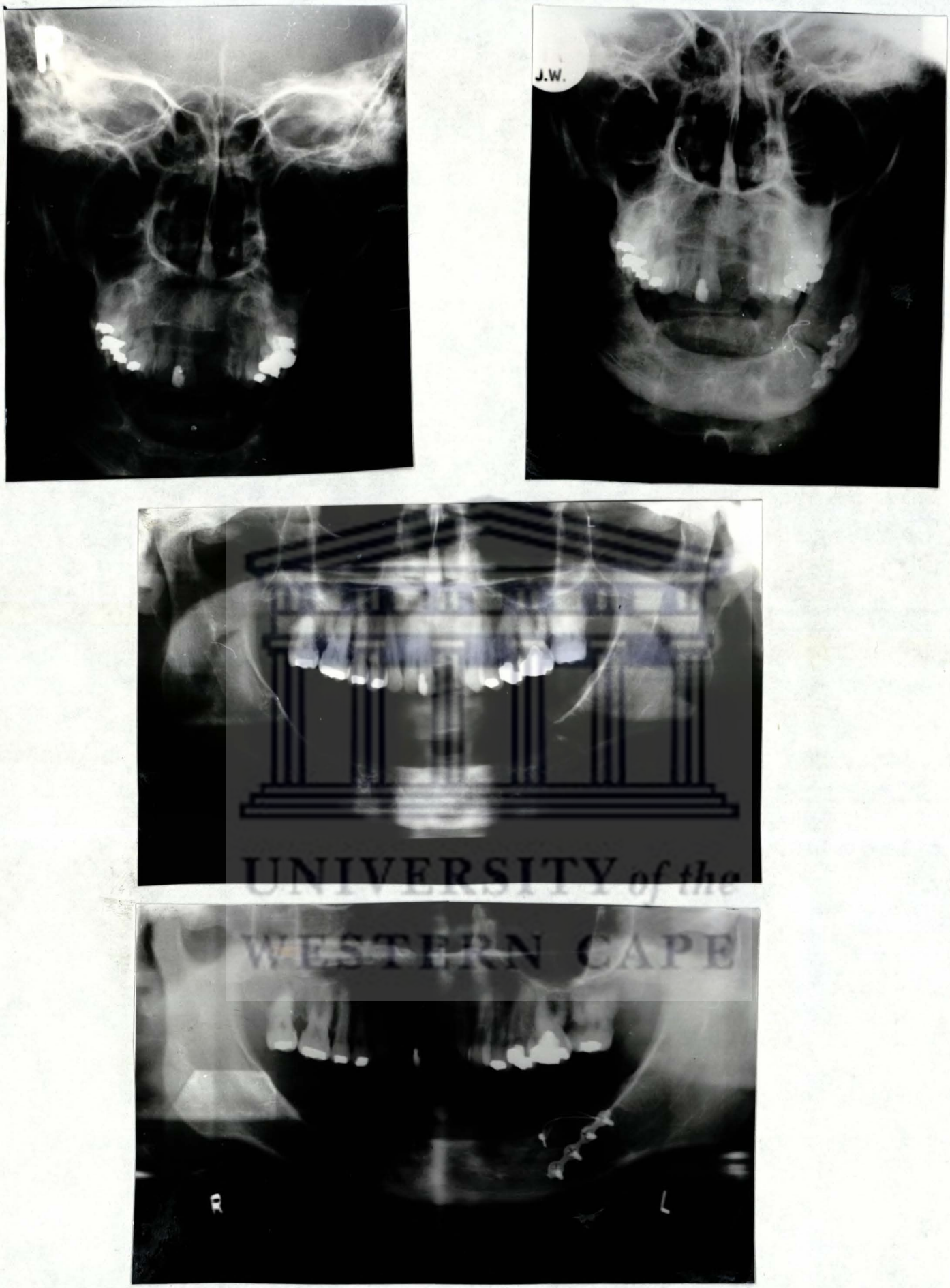


Figure 9: Combination of wiring and plating

The use of compression plates have been widely described. In the Department of Maxillofacial and Oral Surgery at Groote Schuur Hospital only the non-compression plates made of titanium are used. Bekker (1974) reports on two problems of the compression plate technique, namely:

a. the plate is fixed only on the "pressure side" of the fracture and not on the "tension side". This results in distraction of the fragments on the opposite side of the plate.

b. the shape of the mandible may cause inaccuracy in positioning the plate resulting in distraction.

The use of bicortical screws may lead to injury of the neurovascular bundle. Levine and Goode (1981) reported infections in 14 of 15 patients treated with compression plates. They proposed that the advantages of eccentric dynamic compression plate reduction over other methods were:

- The fracture line is brought completely in dynamic compression at both the inferior and superior borders of the mandible due to plate design,
- Patients are able to eat normal food in 7-10 days,
- There is no need for intermaxillary fixation,
- Incidence of caries due to intermaxillary fixation is eliminated,
- There is minimal weight loss,
- Patient can return to work in 7-10 days,
- Eliminates intermaxillary fixation in patients who are physically or mentally handicapped,
- Hospital stay is short.

The above was collaborated by Stelzow and Friedman (1982).

Tu et al (1985) reported complications in four of 35 patients treated with compression plates. Two plates were removed for persistent paraesthesia, one due to infection and one because the screw was placed in the mandibular canal. Peled et al (1989) reported a complication rate of 17% (13

of 76 patients). Malocclusions were noted in six patients and soft tissue infections in 7 patients. These results are similar to those of other studies (*Souyris et al, 1980; Cawood, 1985; Tu et al, 1985; Ardary, 1989; Luhr et al, 1996*). Luhr et al (1996) reporting on compression plates in the treatment of atrophic edentulous mandibles, recommended that in Class III (less than 10 mm in height) atopic mandibles, supraperiosteal plates should be placed.

Jones and Van Sickles (1988) reviewed the concepts and treatment of fractures with regards to rigid fixation and reported that: "the principles of compression bicortical nonflexible systems are in diametric opposition to those of monocortical flexible systems; yet both produce good results in the treatment of fractures".

Ellis (1993) states that rigid skeletal fixation of facial fractures has evolved from the principles of orthopaedic surgery. The benefit to patients of having early use of the jaws and exact placement of bony fragments outweigh the disadvantages.

Moberg et al (1989) investigated the metal released from chrome-cobalt, nickel-chromium and titanium and reported that with the exception of titanium, higher concentrations of the other metals were found in the tissue adjacent to the plates. However, no corrosion, macroscopic or microscopic, was noted on the surfaces of the plates or screws.

Brown et al (1989) evaluated the fate of miniplates in facial trauma and orthognatic surgery and found that the morbidity of retaining plates is within acceptable limits and that routine removal of plates after three months as advocated by Champy may be unnecessary and endorses the

recommendations of Jackson et al (1986) that plates should be retained unless their removal is clinically indicated.

3.13.3 Treatment of infected fractures

In a study of 37 patients with 42 infected mandibular fractures, Johanssen et al (1988) reported that primary bone healing occurred in 28 patients (76%). In nine patients (24%) the preoperative infection persisted. Seven of the nine patients were abusers of either alcohol or narcotics. They recommended rigid internal fixation with miniplates in cases of infected mandibular fractures if proper curettage of infection, rigid Osteosynthesis and specific antibiotic therapy is followed. Koury and Ellis (1992) reviewed the literature and reported that treatment of infected fractures by rigid internal fixation was biologically sound and proposed the following protocol for the management of these fractures:

- If a patient presents with a mild to moderate cellulitis or a spontaneously draining abscess, the patient is treated by open reduction and internal fixation with the placement of a drain for post-surgical irrigation with saline. Intravenous antibiotics is given in the preoperative period.
- If a patient presents with severe cellulitis or a closed (non-draining) abscess, the patient is treated as any patient with an infection, with intravenous antibiotics and incision and drainage. After 3-4 days, the patient is taken to surgery for open reduction and fixation of the fracture. A drain is left in following surgery for continued saline irrigations. In both instances, the potential cause of the infection, such as a non-vital tooth, is eliminated.

3.13.4 Comparison between intraosseous wiring and plating

Numerous studies have compared rigid internal fixation by either compression or non-compression plating with traditional intraosseous wiring and intermaxillary fixation. Kellman (1984) reported on 59 cases in which 18 were treated by compression plates and 41 with intraosseous wiring and or intermaxillary fixation. All patients with the plating technique had no major complications. In those receiving traditional methods of treatment there were six malocclusions and seven non-unions. Morgan et al (1992) reported similar findings. Zachariades et al (1996) reported infections in 71 of 568 (12.5%) cases of fractures treated with intraosseous wiring and malocclusions in seven, whereas in the group treated with compression plates, 3.5% of patients developed infections and the same number developed malocclusions. There were also five cases of post - operative Facial nerve palsies and two cases of inferior alveolar nerve hypoaesthesia in the plated group. Similar findings were reported by other studies (*Dodson et al, 1990; Hoffman et al, 1990; Brown et al, 1991; El-Degini, 1993; Renton et al, 1996*).

Theriot et al (1987) reported that the mean time from injury to surgery was 2.1 days for those treated with wires and 2.7 days for those treated with plates. Operating time for the first group was 1.8 hours compared to 2.2 hours for the second group. Both groups of patients remained in hospital for an average of 3 days postoperatively. Leach et al (1995) reported a higher overall expense and operating time in patients who were treated with plates and this is in keeping with the finding by El-Degini et al (1993). Both studies agree with Thaller et al (1990) that the treatment with plates is more expensive, but in the long term is more cost-effective as the patient enters the work force earlier.

Due to the severe constraints placed on academic complexes, an assessment of treatment modalities and their costs are necessary. Recently the health budget in the Republic of South Africa, both at the national and regional levels have been drastically reduced. This has impacted directly on the reduction in the number of personal employed in the Department of Health. Furthermore, numerous positions that were vacant have been abolished and a moratorium has been placed on future vacancies that may arise.

All departments both at the Faculty of Dentistry of the University of the Western Cape and at Groote Schuur Hospital have been asked to identify areas where reduction in costs may be possible. This study will help determine which of the two modalities of treating fractures of the mandible is less expensive to the Department of Maxillofacial and Oral Surgery and the Department of Plastic and Reconstructive Surgery at Groote Schuur Hospital.

4. AIM AND OBJECTIVES

4.1 Aim

To compare mandibular fractures treated using either rigid internal fixation or traditional intraosseous wiring at Groote Schuur Hospital from 01 January 1993 to 31 December 1995.

4.2 Objectives

1] To determine:

a. the age and gender distribution of the sample

b. the time from injury to presentation for treatment

c. the site of fracture of the mandible

d. the teeth, if any, in the line of fracture

e. preoperative complications

f. the time from presentation to surgery

g. the type of fixation done

h. the duration of the operation

i. the costs incurred for materials used

j. the use of intermaxillary fixation

k. the duration of the hospital stay

l. the period of intermaxillary fixation

m. the post operative complications

n. the duration of the follow-up period

o. the number of follow- up visits on an out patient basis

p. the overall cost of treating a single mandibular fracture (theatre, materials and hospital stay costs).

2] To compare between rigid internal fixation and intraosseous wiring with regards 1] a to 1] p.

3] To recommend a treatment protocol for patients with a single fracture of the mandible.

5. MATERIALS AND METHODS

5.1 Definition of terms

"Maxillofacial and Oral Surgery" that branch of surgery dealing with the diagnosis and the surgical and adjunctive treatment of diseases, injuries, and defects involving the face and structures of the mouth (Jablonski, 1982)

"Fracture" may be defined as a sudden, violent disruption of continuity of bone and may be complete or incomplete in character (Rowe & Williams, 1985)

"Rigid Internal Fixation" direct osseous synthesis by means of plates and screws (Rowe & Williams, 1985).

"Intra-osseous Wiring" direct osseous synthesis by means of stainless steel wires (Rowe & Williams, 1985).

"Theatre time" the time from when the patient enters the theatre to the time, the patient leaves the recovery facility.

5.2 Study design

5.2.1 Study population and sampling

A record based retrospective study of patients that presented to the Department of Maxillofacial and Oral Surgery and Department of Plastic and Reconstructive Surgery at Groote Schuur Hospital from 01 January 1993 to 31 December 1995 was carried out. The folder numbers of patients, treated under general anaesthesia, with open reduction and fixation of mandibular fractures were obtained by a manual search of the operating theatre register. These were entered onto the request forms of the Records Department of Groote Schuur Hospital whose personal then retrieved the folders. Utilising the following inclusion and exclusion criteria, the necessary data was obtained from the clinical notes:

Inclusion criteria:

- all patients treated for fractures of the angle, body, parasymphysis and symphysis of the mandible.

Exclusion criteria:

- all isolated fractures of the ramus and condyle.
- all fractures of the mandible associated with fractures of the midfacial skeleton.
- all fractures of the mandible of gun shot origin.
- all fractures of the body of the mandible associated with any other injury to the patient requiring prolonged hospitalisation of the patient due to:

a. neurosurgical injuries,

b. ophthalmological injuries,

c. ear, nose and throat injuries,

d plastic surgical injuries,

e. vascular injuries,

f. orthopaedic injuries,

g. thoracic injuries and

h. abdominal injuries.

The relevant data documented on a specifically designed proforma (appendix 1).

5.2.2 Measurements

The following data was recorded:

- age
- gender
- time to presentation
- site of fracture
- teeth involved in the fracture line, if any
- pre-operative complications
- time to surgery
- type of fixation
- duration of surgery
- use of intermaxillary fixation

- hospital stay

- duration of intermaxillary fixation

- post operative complications

- duration of follow-up period

- number of follow-up visits

5.2.3 Analysis of costs

The total cost of treating a single fracture of the mandible was determined as the sum of the theatre cost, cost of the materials used and the ward tariff for each patient.

5.2.3.1 Theatre tariff

A single theatre tariff of R15.00 per minute is applicable to all patients as per Groote Schuur Hospital Memorandum dated 12 September 1996 (appendix II).

5.2.3.2 Costs of materials

The costs for the plates and screws of the Wurzburg System is as per the consumable pricelist of the supplier, Stratmed c.c., dated 19 August 1996 (appendix III). The cost of a roll of R.M.Ligature Wire 0.018 (E-129) is R34.86 as per the price of the supplier, Millner's Dental, dated 21 February 1997. The length of one roll of wire is 23 meters. A length of approximately 0.5 meters is used for each intraosseous wiring which this costs R0.76 (appendix IV).

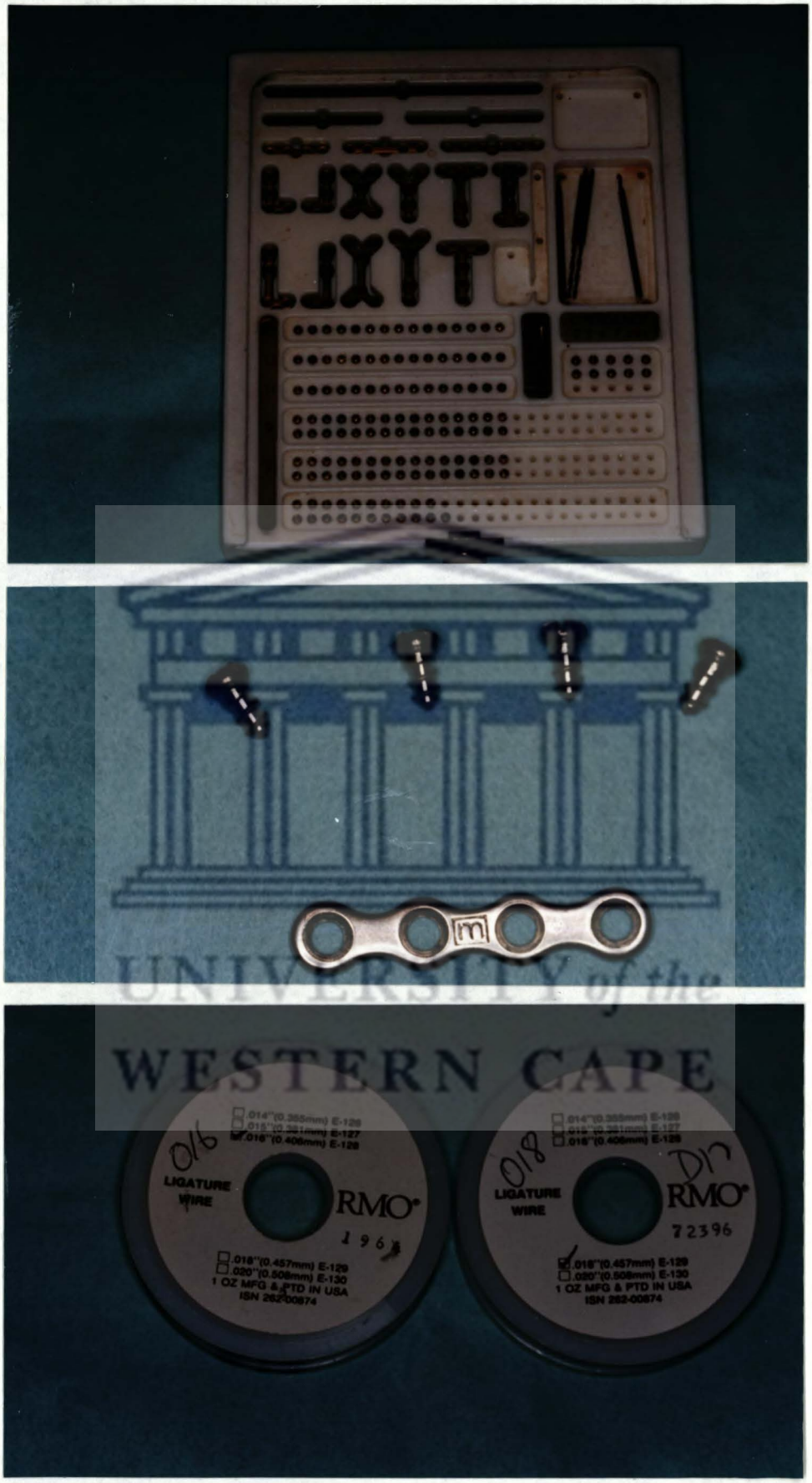


Figure 10: The Leibinger Titanum Miniplate System and 0.016 & 0.018 S.S. wires

5.2.3.3 Ward tariff

The ward tariff was determined as a commuted amount by Groote Schuur Hospital Management per day.

5.3 Data capturing and analysis

The data was captured into the QUATTRO - PRO database package. The Epi - Info statistical package was used to analyse the data and to determine the frequency distributions of the different variables and to test for significant differences between the modalities of treatments rendered.

The results are presented as comparisons between the treatment procedures in the form of tables.

5.4 Staff, facilities and equipment

Facilities of the department of Maxillofacial and Oral Surgery of the Faculty of Dentistry, University of the Western Cape at Groote Schuur Hospital were utilised in consultation with the clerical staff for accessing the records.

5.5 Ethical and legal considerations

Strict patient-doctor confidentiality was maintained. Only the folder numbers of the patients were used to access the clinical records and transfer data onto the prescribed proforma. The data was accessed by one researcher.

Permission for the use of records was obtained from the medical superintendent of Groote Schuur, Hospital (Appendix V).

6. RESULTS

6.1 Sample size

A manual search of the records of the hospital from January 1993 to December 1995, revealed 749 patients who were treated for fractures of the mandible. Applying the aforementioned inclusion and exclusion criteria resulted in **199** patients being included in this study.

6.2 Age and Gender distribution of the sample

The age of the patients ranged from 15 years to 60 years. The mean age was 32.5 years with 75% of the patients below 39 years of age. The gender distribution showed that the sample comprised 155 male patients (78%) and 44 female patients (22%) that is a male to female ratio of approximately 4:1

Table 4: Frequency distribution of age by gender

Age (years)	Male		Female	
	No.	%	No.	%
<20	7	4	2	1
20-29	58	29	15	7.5
30-39	54	27	17	8.5
40-49	30	15	9	4.5
50+	6	3	1	0.5
Total	155	78%	44	22%

6.3 Time from injury to presentation

The majority of the patients presented within 48 hours for treatment (68%). The Table 5 below shows the percentage of patients with regards to the time to presentation.

Table 5: Frequency distribution of time to presentation

Time to Presentation (in hours)	Percentage
1	2
6	14
12	26
24	16
48	11
>48	32

5.4 Site of fracture

The angle of the mandible was the most common site of fracture (75.5%). The distribution of the fractures by site is presented in Table 6.

Table 6: Frequency distribution of fracture sites

Site	Frequency (N=199)	Percentage
Angle	150	75.5
Body	25	12.5
Parasymphysis	17	8.5
Symphysis	7	3.5

6.5 Teeth in the line of fracture

Of the sample of 199 patients, 36 were edentulous (18%), 148 had teeth involved in the line of fracture (74%) and 15 had no associated teeth involved in the line of fracture (8%).

6.6 Pre-operative complications

The most common pre-operative complication was paraesthesia (40%). The majority of the patients had no complications (56%).

Table 7: Frequency distribution of pre-operative complications

Complication	Frequency (N=199)	Percentage
None	111	56
Paraesthesia	79	40
Sepsis	5	2
Lacerations	3	1.5
Other	1	0.5

6.7 Duration to surgery

A total of 168 patients (84.4%) were treated within 10 days (240 hours). The other 31 patients (15.6%) presented late and were treated after 240 hours.

Table 8: Frequency distribution of duration to surgery

Days	Number	Percentage
<1	14	7
1-2	30	16
3-5	76	38
5-10	48	24
>10	31	15
Total	199	100

6.8 Method of fixation

An analysis of the records showed that 123 patients (61.8%) were treated by intraosseous wiring, 59 patients (29.6%) by rigid internal fixation (plates) and 17 patients (8.5%) by a combination of both methods. The commonly used methods and materials are presented in Table 9.

Table 9: Frequency distribution of methods of fixation

Method of fixation	Frequency (N=199)	Percentage
Single wire	97	48.7
Two wires	22	11.1
Plate + 4 screws	34	17.1
Plate + 4 screws & single wire	11	5.5
Two plates + 8 screws	18	9.1
Other combinations	17	8.5

6.9 Operating time

The shortest recorded time for an operation was 40 minutes and the longest was 340 minutes. The mean time was 90 minutes.

Table 10: Frequency distribution of operating time

Time (minutes)	Number	Percentage
40-50	13	7
51-60	21	10
61-70	31	16
71-80	26	13
81-90	30	15
91-100	23	12
101-110	14	7
111-120	14	7
>120	26	13
Total	199	100

6.10 Cost of operating time

The cost for the shortest procedure was R600.00 (that is an operating time of 40 minutes) and for the longest was R5100.00 (that is an operating time of 340 minutes) with a mean cost of R1355.80.

6.11 Cost of materials

In 97 patients (48.5%) only a single wire was used at a cost of R0.76 each and in 22 patients two wires were used costing R1.52. A single 4-hole plate with 4 screws was used in 34 patients

(17.1%) at a cost of R435.42 per unit and a single wire in combination with a 4-hole plate and 4 screws were used in 11 patients (5.5%) costing R436.18 per unit. When two 4-hole plates and 8 screws were used in 18 patients (9%), the cost was R870.84 per unit.

6.12 Intermaxillary fixation

From the Table 11 below, it is noted that 61.3% of all patients were placed into inter maxillary fixation.

Table 11: Frequency of the use of intermaxillary fixation

IMF	Frequency (N=199)	Percentage
Yes	122	61.3
No	77	38.7

6.13 Duration of hospital stay

The shortest stay recorded was 0.5 days and the longest 16 days. A total of 163 patients (80%) were admitted to the general ward for less than 6 days with a mean of 3 days. The number of patients admitted to hospital for 2 days or less was 50 (25%).

6.14 Duration of Intermaxillary fixation

The duration of IMF varied between 6 days and 74 days. A total of 94 patients (47%) were placed into intermaxillary fixation for 42 days (6 weeks) or less with a mean of 36.5 days. Those that were not placed into IMF numbered 82 patients (41%).

6.15 Post-operative complications

The majority of the patients treated (64.8%) had no complications. Transient paraesthesia was recorded in 44 patients (22.1%) and permanent paraesthesia in 15 patients (7.5%). Table 12 represents the complications rates.

Table 12: Frequency distribution of post-operative complication rates

Complication	Frequency	Percentage
None	129	64.8
Paraesthesia (transient)	44	22.1
Paraesthesia (permanent)	15	7.5
Sepsis	3	1.5
Malunion	5	2.5
Non-union	1	0.5
Delayed union	2	1

6.16 Follow-up period

The mean follow-up period was 31 days with 11 patients (5.5%) lost to follow-up.

6.17 Reasons for removal of fixation

Table 13 shows that 94% of the patients did not require removal of the material of fixation. Exposure of the material in 7 patients (3.5%) necessitated the removal of said material.

Table 13: Reason for the removal of the fixation material

Reason	Frequency (N=199)	Percentage
Not removed	187	94
Sepsis	3	1.5
Exposed	7	3.5
Dislodged	1	0.5

6.18 Frequency Distribution of Follow-up visits

Approximately half of the patients (47%) presented twice for recall visits and 21% presented at least once. Table 14 represents the frequency and percentages of the number of follow-up visits.

Table 14: Frequency distribution of the number of follow-up visits

Number of Visits	Frequency (N=199)	Percentage
0	17	8.5
1	41	21
2	94	47
3	31	15.5
4	9	4.5
5	5	2.5
>5	2	1

7. COMPARISONS BETWEEN THE DIFFERENT MODALITIES OF TREATMENT

7.1 Age and type of fixation

In the age group below 32 years, 77.2% were treated with wires, while in the group older than 32 years, an almost equal number were treated with either wires or plates. The age of 32 years was selected as this was the mean age of the sample. The p value indicates a significant difference with regards the treatment modalities used in patients below and above 32 years of age.

Table 15: Types of fixation by age categories

Age	<32 Years		>32 Years	
	Frequency (N=101)	%	Frequency (N=98)	%
Plates	19	18.8	40	40.8
Wiring	78	77.2	45	45.9
Plates/wires	4	4	13	13.3

p value < 0.05

7.2 Duration to presentation

This shows that patients who had plates and screws placed presented the earliest whereas those who had both wires and plates placed presented later. This difference was however not statistically significant.

Table 16: Duration to presentation by type of fixation

	Frequency (N=199)	Mean (hours)
Plates	59	56
Wiring	123	70
Plates/wires	17	84

p value > 0.05

7.3 Teeth in the line of fracture

In the majority of patients who where edentulous, plates were used (55.6%), whereas in the dentate patients wires were more frequently used. The p value indicates a significant difference between the treatment modality and tooth involvement in the line of fracture.

Table 17: Teeth in the line of fracture by modality of treatment

	Teeth involved (N=148)	Teeth not involved (N=15)	Edentulous (N=36)
Plates	24.3%	20.0%	55.6%
Wiring	70.9%	47.7%	30.6%
Plates/wires	4.7%	33.3%	13.9%

p value < 0.05

7.4 Duration to surgery

The duration from time of injury to surgery was the longest for the group of patients who had intraosseous wires placed but was not significantly different from those who had plates and screws placed. The mean difference was 3 hours. However, those who were treated with the combined method were taken to theatre earlier (mean difference of 29-32 hours). The p value indicates that the difference is not significant.

Table 18 represents the mean times in minutes for the various treatment modalities.

Table 18: Frequency distribution of duration to surgery by modality of treatment

Duration to surgery	Frequency (N=199)	Mean (Hours)
Plates	59	156
Wiring	123	153
Plates/wires	17	124

p > 0.05

7.5 Operating time

The placement of a plate with screws was the shortest recorded procedure with a mean time of 82 minutes. When wires were used the procedure was approximately 10 minutes longer and when both plates and wires were used the time taken was 105 minutes. The p value indicates a significant difference in the operating time for the different modalities of treatment.

Table 19: Operating time by modality of treatment

Procedure	Mean (minutes)
Plating (N=59)	82
Wiring (N=123)	92
Plate/wire (N=17)	105

p value < 0.05

7.6 Intermaxillary fixation

In the group treated with wires, 83% of patients were placed into intermaxillary fixation whereas 76% of those treated with plates and screws were not placed into intermaxillary fixation as indicated in Table 20. Once more the p value indicates a significant difference between the treatment modalities.

Table 20: Intermaxillary fixation by modality of treatment

IMF	Yes	No
Plates	24	76
Wiring	84	16
Plates/wires	29	71

p value < 0.05

7.7 Duration of hospital stay

The mean duration of the hospital stay for those patients in whom plates or a combination of plates and wires were used was 4 days. Those who had wires placed usually stayed for 1.5 days longer. The p value however indicates that this difference is not significant

Table 21: Duration of hospital stay by modality of treatment

Procedure	Mean	Minimum	Maximum
Plating	4	0.5	10
Wiring	5.5	1	16
Plate/wire	4	1	14

p value > 0.05

7.8 Duration of Intermaxillary fixation

The mean duration of intermaxillary fixation for each group is represented in Table 22 and the p value indicates significant differences in the duration for each group. Patients who were treated with intraosseous wires remained in intermaxillary fixation for a longer period of time (mean of 30 days) as compared to those who had plates and screws placed (mean of 8 days). Patients treated with the combination modality were placed into intermaxillary fixation for a mean period of 13 days.

Table 22: Duration of intermaxillary fixation by modality of treatment

Modality	Mean (days)
Plates	8
Wiring	30
Plates/wires	13

p value < 0.05

7.9 Post - operative complications

The patients treated with wires had the least percentage of complications (27%) and those treated with a combination of plates and wires had the most (53%). The incidence of transient paraesthesia was similar in all groups while permanent paraesthesia was 50% less common in the group treated with wires as compared to the other groups. The p value indicates that there is no significant difference.

Table 23: Post-operative complication rates by modality of treatment

Complication %	Plating (N=59)	Wiring (N=123)	Plate/wire (N=17)
None	53	73	47
Paraesthesia (trans)	29	18	29
Paraesthesia (perm)	10	6	12
Sepsis	3	1	0
Malunion	3	1	6
Non-union	2	0	0
Delayed union	0	1	6

p value > 0.05

7.10 Follow up visits

Patients treated with wires and a combination of plates and wires usually presented twice. Those patients treated with plates frequently presented twice or thrice with 15.3% not presenting at all. Table 24 shows the number of follow-up visits as a percentage of each modality of treatment. The p value again indicates that the difference is not significant.

Table 24: Frequency of follow-up visits by modality of treatment

Number	Plates (N=59)	Wiring (N=123)	Plate/wire (N=17)
0	16	7	0
1	27	17	23
2	27	55	59
3	15	15	12
4	9	3	6
5	5	2	0
7	0	1	0
11	2	0	0

p value > 0.05

The mean follow-up visits for all patients was 2.

7.11 Total costs

The mean cost of treating a patient with a combination of plates and wires was the highest. The cheapest method cost R601.00 in a patient treated with wires and the most expensive was R5971.00 in a patient treated with plates and screws. The mean cost of treating patients with plates was approximately R450.00 more than that of patients treated with wires. The p value indicates significant differences in the costs of the different modalities of treatment. This difference can be attributed to the fact that plates and screws do cost significantly more than wires. When comparing the mean time of the operations, plating of the mandible took 10 minutes less than wiring and hence decreases the cost in this component of total costs. The placement of plates and wires increased the time in theatre by 13 minutes over wiring and by 23 minutes over plating.

Table 25: Total costs in rands by modality of treatment

Procedure	Mean	Minimum	Maximum
Plating (N=59)	1834.07	1035.00	5971.00
Wiring (N=123)	1383.98	601.00	2476.00
Plate/wire (N=17)	2118.06	1111.00	4937.00

p value < 0.05

7.12 Summary of results

Teeth in the line of fracture, operating time, intermaxillary fixation and it's duration and total costs show significant differences between the different modalities of treatment. However, duration of hospital stay and post-operative complications were not significantly different. Table 26 represents the different variables in the study and any significant differences.

Table 26: Significant differences of characteristics

Characteristic	Significant difference
Age and fixation	Yes
Time to presentation	No
Teeth in line of fracture	Yes
Duration to surgery	No
Operating time	Yes
Intermaxillary fixation	Yes
Duration of hospital stay	No
Duration of intermaxillary fixation	Yes
Post-operative complications	No
Number of follow-up visits	No
Total costs	Yes

8. DISCUSSION

8.1 Age and Gender

In this study the mean age of the patients was 32.5 years which is slightly higher than that of other studies in which it was reported that the incidence was below 30 years of age (*Hagan et al, 1961; Hulke et al, 1964; James et al, 1981; Olson et al, 1982; Winstanley, 1984; Shepherd et al, 1988; Mwaniki et al, 1990; Adi et al, 1990; Lownie et al, 1996*). With regard to gender distribution, this study concurs with that of other studies of a male to female ratio of 4 : 1(*Hagan et al, 1961; Hukle et al 1964; James et al, 1981; Olson et al, 1982; Winstanley, 1984; Shepherd et al, 1988; Mwaniki et al, 1990; Adi et al, 1990; Lownie et al, 1996*).

8.2 Time of injury to presentation/surgery

The majority of patients (68%) in this study presented for treatment within 2 days. Those who were treated with plates presented within 2.5 days whereas those who had wires placed, presented within 3 days. Patients who were treated with a combination of plates and wires presented within 3.5 days. With regards to time elapsed from injury to surgery, those who were treated with plates waited 6.5 days and those who had wired plates was 6.4 days. However those who were treated with a combination of both plates and wires waited only 5 days.

It appears that our patients wait longer to be treated as compared to those of other studies (Theriot et al, 1987; Hoffman et al, 1990; Morgan et al, 1992). Reasons for a delay in presentation could be:

- distances that patients have to travel to get to Cape Town from where they are injured. The unit services the entire Western Cape region, the majority of the Northern Cape and parts of the Eastern Cape.
- patients who sustain injuries in the Cape metropole are first attended to at one of the primary health care facilities before being referred to a tertiary hospital.

Reasons for a delay in the patient being treated are:

- the Department of Maxillofacial and Oral Surgery is faced with the problem of a lack of operating time at Groote Schuur Hospital.
- operating time can be obtained in the Trauma Unit facilities to treat patients with fractures whenever they are available during weekdays.
- patients with isolated mandibular fractures who are assessed in the trauma unit on the week-end are discharged and asked to return as out-patients to the department the following week.

Table 27: Duration from injury to surgery

Study	Year	Plating (days)	Wiring (days)
Theriot et al	1982	2.7	2.1
Hoffman et al	1990	5.4	5.4
Morgan et al	1992	4.0	6.0
Leach	1995	2.0	1.5
Rughubar	1997	6.5	6.4

8.3 Site of fracture

In this study, the angle of the mandible was the most common site of fracture. This is similar to findings by other authors who reported on fracture sites in patients involved in interpersonal violence (*Frost et al, 1983; Winstanley, 1984; Johansson et al, 1988; Shepherd et al, 1988; Mwaniki et al, 1990; Adi et al, 1990; Rix et al, 1991; Smith et al, 1991; Telfar et al, 1991; Lownie et al, 1996*).

8.4 Teeth in the line of fracture

This study revealed the 74.4% of patients had teeth involved in the line of fracture. This is significantly higher than the 39% reported by James et al (1981) and Renton et al (1996). Patients who had intraosseous wires placed accounted for 71 % of patients with teeth involved in the line of fracture. With regard to the group receiving plates, an equal number had teeth in the line of fracture and no teeth involved.

Edentulous patients made up 18.1% of the sample. Most of the edentulous patients were plated. This is in keeping with other studies (James et al, 1981; Renton et al, 1996).

8.5 Preoperative complications

This study shows that 56% of patients had no preoperative complications while 40% of patients had paraesthesia of the inferior alveolar nerve or mental nerve. This is in keeping with the results of other studies in the literature (James et al, 1981; Winstanley et al, 1984; Tu et al, 1985; Widmark et al, 1991).

The prevalence of pre-operative complications may be an under-estimate, as this study is a retrospective one, relying on the clinical notes of many different clinicians with varying levels of experience. It is not known if a complete and thorough examination of the patient was carried out to determine pre-operative complications.

8.6 Duration of operation

The average operation time was 90 minutes. The time required for placing a plate (82 minutes) was shorter than for those receiving a wire (92 minutes). When a combination procedure was performed, the time was 105 minutes. Other authors report longer times for plating than wiring. (*Theriot et al 1987; Thaller et al 1990; Leach et al 1995*). This could be due to the improvements regarding plating techniques and also the increased number of cases being treated with plates. Operating time is also directly related to the experience of the surgeon. Zachariades et al (1996) demonstrated an increase in the number of cases treated by plates from 1984 - 1993 and a decrease in the number of cases treated with wires during the same period.

8.7 Intermaxillary fixation

In the group of patients treated with intraosseous wiring, 84% were placed into intermaxillary fixation as opposed to 11.5% of those who were plated. In the group that received a combination of plates and wires, 29% were placed into intermaxillary fixation. It would appear that in this study a larger number of patients who received plates were placed into intermaxillary fixation when compared to other studies in the literature (*Champy et al, 1978; Levine et al, 1980; Souyris et al, 1980; Frost et al, 1981; Cawood, 1985; Wald et al, 1986; Moore et al, 1990; Levy et al, 1991; Smith, 1991; Hayter et al, 1993; Ellis, 1993*). This may be attributed to the fact that in the Department of Maxillofacial and Oral Surgery at Groote Schuur Hospital dentate patients are placed into intermaxillary fixation prior to the plates and screws being fixed into position. The teaching at this institution is that these patients are to be kept in intermaxillary fixation for a minimum of 7-14 days so as to make the patient comfortable and help reduce the pain.

With regards to the duration of intermaxillary fixation, this study shows that patients who received wires were placed into intermaxillary fixation for an average of 29.5 days (approximately 4 weeks) while those who received plates were placed into intermaxillary fixation for 7.7 days (approximately one week). This is in keeping with the literature quoted above. It must be remembered that many edentulous patients had plates placed and hence could not be placed into intermaxillary fixation.

8.8 Duration of hospital stay

In this study, 80% of all patients were admitted to hospital for less than 6 days with the mean of 4.5 days with 25% of the patients spending 2 days or less in hospital. Patients who received plates or a combination of plates and wires had a mean stay of 4 days whereas those who had intraosseous wiring had a mean stay of 5.5 days. Our patients spent a longer time in hospital than those of Brown et al (1991) of 3.1 days and 3.6 days for plates and intraosseous wiring respectively, but shorter time than those of El - Degwi et al (1993) of 8.6 days and 6.3 days respectively.

8.9 Period of follow up

The mean follow-up period of our sample was 31 days. This includes patients from all three modalities of treatment. This is in keeping with other studies in the literature (*El-Degwi et al, 1993*). This study shows that 11 patients (5.5%) were lost to follow-up. The period of follow-up is dependent upon the duration of intermaxillary fixation.

8.10 Number of follow - up visits

The majority of patients (76.3%) presented twice or less for follow-up including 8.5% who did not present for follow up at all. The most number of follow-up visits was 11 (0.5%).

All patients who had a combination of plates and wires presented for follow-up as compared to 6.5% of those who had intraosseous wiring placed and 15.3% who had plates placed who did not present for follow up. This non-attendance could be due to these patients being edentulous and hence beginning to function almost immediately after fixation of their fractures. The majority of patients presented twice irrespective of the treatment modality. It is the policy at Groote Schuur Hospital to review all patients one week post-operatively to assess them for any complications and to adjust the intermaxillary fixation if it was placed. The patients are then recalled 4-5 weeks later to assess the healing and remove the intermaxillary fixation. This is much lower than the results of El -Degwi et al (1993) who reported that patients with plates presented 5.4 times and those with intraosseous wiring 4.8 times.

8.11 Postoperative complications

The majority of the patients had no complications (64.8%). Transient paraesthesia accounted for 22% of complications followed by permanent paraesthesia in 7.5% of patients. Malunion was recorded in 2.5% of patients and infection in 1.5% of patients.

The higher rate of permanent paraesthesia compared to other studies (*Battersby, 1967; Winstanley, 1984*) could be attributed to complete severance of the nerve at the time of injury. This complication was noted to be higher in patients who had plates placed (10%) or a combination of plates and wires (12%) when compared with intraosseous wiring (6%). Incidence of transient paraesthesia was noted to be similar in all groups and is in keeping with other studies (*Battersby, 1967; Strelzow et al, 1982; Winstanley, 1984; Cawood, 1985; Tu et al, 1985; Niederdellman et al, 1986; Wald et al,*

1988; Luhr et al, 1989; Peled et al, 1989; Hoffman et al, 1990; Moore et al, 1990; Levy et al, 1991; Rix et al, 1991; Hayter et al, 1993).

No infection was recorded in the group with a combination of plates and wires while an infection rate of 3% was recorded in the group of patients who had plates placed and 1% in the group who had wires placed. Infection rates were also much lower than all reported studies. (*Battersby, 1967; Strelzow et al, 1982; Winstanley, 1984; Cawood, 1985; Tu et al, 1985; Niederdellman et al, 1986; Wald et al, 1988; Luhr et al, 1989; Peled et al, 1989; Hoffman et al, 1990; Moore et al, 1990; Levy et al, 1991; Rix et al, 1991; Hayter et al, 1993*).

Malunion was recorded in 6% of patients in the combination group and as 3% in the plated group and 1% in the wired group. The incidence of malunion and non - union is much lower than those reported in the literature (*Kellman, 1984; Theriot et al, 1987; Hoffman et al, 1990; Thaller et al, 1990*).

8.12 Total costs

The total costs for treating a patient included the cost of theatre time, cost of materials used and the cost of hospital stay. Theatre time at Groote Schuur Hospital is calculated at R15.00 per minute (appendix III). Hence it is possible to calculate the cost per case treated. Costs of the plates and screws were as per price list of the supplier (appendix II). The cost of the stainless steel wire was calculated by determining the cost of 0.5 metres of wire (approximate length of wire used for intraosseous wiring). This was calculated as R0.76 per length.

Unfortunately the cost of the hospital stay is not available as a single amount as is the cost to the hospital of a single out-patient visit. In this study it has been accepted that the longer the hospital stay and the more frequent the out-patient visits, the less cost-effective is the modality of treatment.

The operating time for plating is noted to be less than that of intraosseous wiring or the combination group, that is a mean difference of 10 minutes between the plating group and the wiring group. When calculating theatre costs at R15.00 per minute, it costs on the average R150.00 more to treat a patient with wires than with plates and screws. Costs of materials is higher when plates are used. An analysis of the overall calculated costs shows that on an average the cost of treating a patient with plates was approximately R470.00 more than for intraosseous wiring. This figure is double if two plates are utilised.

As this study showed that there was no significant difference in the duration of hospital stay, this variable can therefore be ignored.

One should also consider the cost incurred in purchasing expensive oral fluid substitutes for patients with intermaxillary fixation as compared to allowing a patient who has plates placed to eat/consume a soft or semi-solid diet.

With the rate of post-operative complications being similar, it can be assumed that the placing of plates and screws would be as successful a procedure as intraosseous wiring.

8.13 Shortcomings of the study

Some of the shortcomings of this study are:

- the cause of the fracture was not recorded
- pre-operative complications were not accurately recorded and this could influence the post-operative complication rates
- the site of fracture was not standardised and hence the operating time could not be entirely correct
- this study has not included the level of experience of the surgeon, anaesthetist and theatre staff as variables
- another variable not considered is the presence or absence of a competent surgical assistant
- there is no protocol in place at Groote Schuur Hospital with regards the admission and discharge of patients with fractures of the mandible.

These variables, with the exception of the first and second, would most definitely impact on the total costs. If this is true then the use of plates and screws will be much more expensive than the use of wires.

9. CONCLUSIONS

An analysis of the data shows that the mean age of the sample was 32 years and the male : female ratio was 4 : 1. The majority of the patients below 32 years of age were treated with wires (77%) and there was an equal distribution of patients who were plated and wired in the age group older than 32 years. The age incidence indicates that the younger, active members of the population are affected.

There was no significant difference in the duration to presentation for the different modalities of treatment which was on the average between 2 and 4 days. Edentulous patients were plated more often (55.6%) and wires were placed more frequently in dentate patients irrespective of whether there was a tooth in the line of fracture. As with the duration to presentation, there was no significant difference in the duration to surgery. On an average the patients waited 7 days before being treated. This is representative of the problem of available theatre time.

The mean operating time for patients who were plated was the shortest. Wiring and the combination procedure were more time consuming. Patients in the group that were wired were placed into intermaxillary fixation more frequently than those who were plated or had the combination procedure performed. There was no appreciable difference in the duration of hospital stay between the different groups.

Intermaxillary fixation was maintained for approximately 4 weeks in patients who were wired and only for about 1 week in the plated group. This however includes the edentulous patients as well.

Post-operative complications were most common in the group that had both plates and wires placed and least common in the wired group. Transient paraesthesia was common to all groups with a similar frequency in each. The highest rate of permanent paraesthesia was recorded in the group with the combination procedure. The incidences of the other complications were low for all the groups.

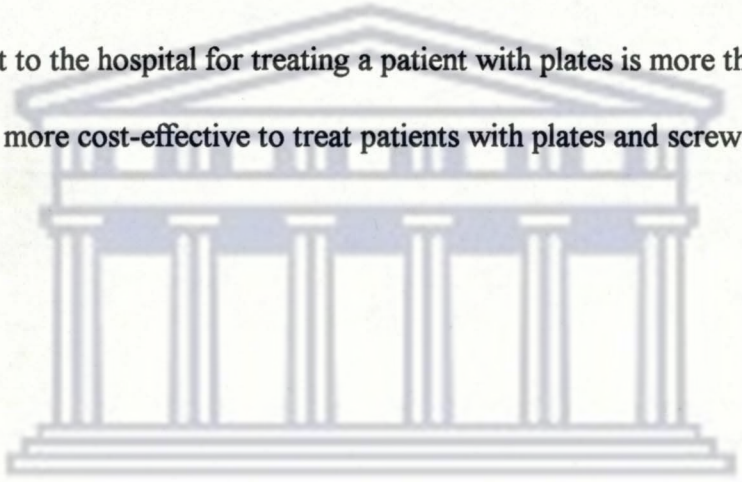
The mean number of follow-up visits was similar for all groups, with about 85% of patients presenting for follow-up visits on an out-patient basis. The duration of follow-up depended on whether the patient was placed into intermaxillary fixation.

This study shows that there were no significant differences in the duration of hospital stay and hence the cost thereof can be excluded from the calculations. There were however significant differences in the theatre time and the cost of materials. As calculated earlier, it costs approximately R150.00 more to treat a patient with wires than with plates in an operating theatre. However, the costs of a single plate and four screws is approximately R470.00 more than the cost of the length of wire used. Hence it can be calculated that the use of plates and screws cost approximately R320.00 more than using wires. This figure is double when two plates and eight screws are used and increases exponentially as the number of plates and screws used increases.

Due to the fact that patients who have had plates placed can return to a life-style similar to one before the fracture earlier as they are not, if at all, in intermaxillary fixation as long as patients with intraosseous wires, it would be of benefit to the patient. This concurs with reports of other authors (*Thaller et al, 1990; Brown et al, 1991; Zacariades et al, 1996*).

With the constraints that have been placed both financially and regards personal in the public health sector, treating patients with wires instead of plates will appear more viable. The health budget has been drastically reduced both nationally and regionally in South Africa. This implicates directly on the treatment modalities available. Payment for the plates and screws have to be made regularly to the suppliers and hence is directly related to the budget. However cost of theatre time and hospital stay can be absorbed into the overall budget of the institution with less detriment to the budget.

Although the cost to the hospital for treating a patient with plates is more than for intraosseous wiring, it may be more cost-effective to treat patients with plates and screws.



10. Recommendations

- a proforma be designed for the examination of patients with mandibular and facial fractures
- a protocol be developed regarding admission and discharging of patients with mandibular and facial fractures
- a protocol be devised for the radiographic views needed to diagnose and treat mandibular fractures
- that dentate and partially dentate patients be treated with wires and intermaxillary fixation unless contra-indicated with regards airway, neurological and physiotherapy problems.
- edentulous patients be treated with two wires in angle of the mandible fractures
- fractures of the symphysis, parasymphysis and body in edentulous patients be treated with plates after consultation with a consultant in the department
- a prospective study on the comparison of the different modalities of treating fractures of the mandible be conducted with the aforementioned recommendations being considered.

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Appendix I

PROFORMA

CONVENTION INTRAOSSEOUS WIRING vs RIGID INTERNAL FIXATION

CASE NUMBER

FOLDER NUMBER

YEAR

AGE

GENDER

ADDRESS

DURATION TO PRESENTATION [hours]

SITE OF FRACTURE

Ramus	
Angle	
Body	
Parasymphysis	
Symphysis	
Other	

TEETH IN THE LINE OF FRACTURE

Yes	
No	
Edentulous	

PRE-OPERATIVE COMPLICATIONS

Parasthesia	
Sepsis	
Lacerations	
Other	

DURATION TO SURGERY [hours]

TYPE OF FIXATION

I.O.W.	**U.B.W.**	
	L.B.W.	
R.I.F	**No. of plates**	
screws	**No. of**	
	Pos. of plates	

DURATION OF OPERATION [minutes]

INTERMAXILLARY FIXATION

Yes	
No	

DURATION OF HOSPITAL STAY [hours]

DURATION OF I.M.F. [days]

POST-OPERATIVE COMPLICATIONS

Parasthesia (transient)	
Parasthesia (permanent)	
Sepsis	
Malunion	
Non-union	
Pain	
Other	

DURATION OF FOLLOW-UP [days]

REMOVAL OF I.O.W./R.I.F.

Sepsis	
Pain	
Exposed	
Dislodged	
Function	
Other	

DURATION TO REMOVAL OF I.O.W./R.I.F. [days]

NUMBER OF FOLLOW-UP VISITS

Appendix II

GROOTE SCHUUR HOSPITAL REGION

HOSPITAL MEMORANDUM **12 SEPTEMBER 1996**

PROCEDURE MANUAL NO. 18 : REVISED HOSPITAL FEES STRUCTURE WITH EFFECT FROM 1 SEPTEMBER 1996.

1. The existing hospital fees structure has been revised affecting mainly the tariffs and the income ceilings of the various patient-category groups.

2. The following are the most important adjustments which are applicable to the academic, specialised and general hospitals.

2.1 The monthly income ceilings to determine which patient-category the patient must be assessed at have been revised as follows :

CATEGORY	SINGLE UNIT			FAMILY UNIT		
	PREVIOUS	REVISED	%INCREASE	PREVIOUS	REVISED	%INCREASE
H1	R833.33	R916.67	10.0%	R1500.00	R1666.67	11.1%
H2	R1166.67	R1333.33	14.3%	R2166.67	R2416.67	11.5%
H3	R1750.00	R1916.67	9.5%	R2916.67	R3250.00	11.4%

Patients whose income exceeds the maximum of the H3 category are classified as private hospital patients.

2.2 **IN-PATIENTS : ADMISSION TARRIFS**

Hospital Patients (Tariff per 30 days or part thereof)

CATEGORY	PREVIOUS TARIFF	REVISED TARIFF	% INCREASE
H1	R 26.00	R 37.00	42.3%
H2	R129.00	R187.00	45.0%
H3	R194.00	R280.00	44.3%

1

Private ("Doc Pat")/Private-Hospital Patients

WARD	PREVIOUS TARIFF	REVISED TARIFF	% INCREASE
General	R258.00 per day	R373.00 per day	44.6%
High Care	R409.00 per day	R946.00 per day	131.3%
Intensive Care	R766.00 per day	R1481.00 per day	93.3%
Professional Fees (Private Patients excluded)	R78.00 per day	R112.00 per day	43.6%

2.3 OUT-PATIENTS : VISIT TARIFFS

CATEGORY	PREVIOUS TARIFF	REVISED TARIFF	% INCREASE
H1	R13.00	R17.00	30.8%
H2	R26.00	R35.00	30.8%
H3	R39.00	R51.00	30.8%
Private (Doc-Pat)/ Private-Hospital Patients	R55.00	R68.00	23.6%

2. 4 SERVICES/ITEMS PAYABLE BY PRIVATE-/PRIVATE- HOSPITAL PATIENTS

SERVICE TYPES	PREVIOUS TARIFF	REVISED TARIFF	% INCREASE
Diagnostic	R51.00	R68.00	33.3%
Laboratory	R51.00	R68.00	33.3%
Pharmaceuticals (In-Patient)	R102.00	R136.00	33.3%
Pharmaceuticals (Out-Patient)	R51.00	R68.00	33.3%
Non-Pharmaceutical Items (Out-Patient)	R51.00	R68.00	33.3%
Computed Tomography	R402.00	R525.00	30.6%
Magnetic Resonance	R1691.00	R2210.00	30.7%
Peritoneal Dialysate	R1806.00	R2611.00	44.6%
Haemodialysis	R258.00	R373.00	44.6%
Oxygen refill per cylinder	R51.00	R68.00	33.3%
Oxygen appliances (once only)	R51.00	R68.00	33.3%

Certain services, including the above, in some areas are billed at itemised rates whilst other areas are under investigation for itemised billing.

2.5 Theatre Tariff

The basic theatre fee of R144.00 for in-patients and R124.00 for out-patients has been discontinued. A new basic tariff referred to as specialised theatre modifiers, in respect of certain Orthopaedic, Neurosurgical, Vascular as well as Cardiac surgical operations has been introduced for in-patients. This, however, will only be applied once the Representative Association of Medical Schemes (RAMS) has granted the necessary approval for the hospital to raise these

tariffs. The Cardiac Theatre has already been approved and the modifyer fee is therefore applicable. A single theatre tariff of R15,00 per minute, applicable to in-patients, has replaced the previous tariff of R7.50 for the first 60 minutes and R10.00 per minute thereafter. Out-patients are also charged R15.00 per minute for use of the theatre facilities.

2.6 MISCELLANEOUS TARIFFS

Transport : Ambulance (per 50km)

CATEGORY	PREVIOUS TARIFF	REVISED TARIFF	% INCREASE
H1	R13.00	R17.00	30.8%
H2	R26.00	R34.00	30.8%
H3	R39.00	R51.00	30.8%
Private-/Private-Hospital Patients	R102.00	R136.00	33.3%

Transport : Non-Ambulance (per 100km)

CATEGORY	PREVIOUS TARIFF	REVISED TARIFF	% INCREASE
H1	R8.00	R11.00	37.5%
H2	R16.00	R21.00	31.3%
H3	R24.00	R32.00	33.3%
Private-/Private-Hospital Patients	R62.00	R84.00	35.5%

2.7 PATIENT COMPANIONS ADMITTED TO THE HOSPITAL

Patient companions may only be accommodated in exceptional cases and are charged a tariff equivalent to the tariff applicable to the patient who is being accompanied.

CATEGORY	PREVIOUS TARIFF	REVISED TARIFF	% INCREASE
H1	R26.00 per admission	R37.00 per admission	42.3%
H2	R129.00 per admission	R187.00 per admission	45.0%
H3	R194.00 per admission	R280.00 per admission	44.3%
Private-/Private-Hospital Patients	R258.00 per day	R373.00 per day	44.6%

2.8 ADMISSION OF BOARDERS, LIVE-IN BABIES AND LIVE-IN CHILDREN

The accommodation tariff applicable to the abovementioned (see definition hereunder) has been increased from R51.00 to R68.00 (33.3%) per day, and is applicable only to the private- and private-hospital patients.

Boarders: A person who with the written authority of the Medical Superintendent is admitted because the persons's presence is essential for the recovery of the patient.

Live-in Baby: A new-born infant of a mother who is still a maternity patient.

Live-in Child: An infant, who does not receive any medical care, of whom the mother is the patient.

2.9 SUPPLEMENTARY HEALTH SERVICES : THERAPEUTIC EXERCISES/GROUP THERAPY

CATEGORY	PREVIOUS TARIFF	REVISED TARIFF	% INCREASE
H1	R26.00	R34.00	30.8%
H2	R52.00	R68.00	30.8%
H3	R78.00	R102.00	30.8%
Private-/Private-Hospital Patients	R102.00	R136.00	33.3%

2.10 MEDICAL REPORTS/RECORDS/CERTIFICATES

The tariff of R202.00 for the original documents has been retained. The supplying of copies of the medical reports, records and certificates has been increased from R62.00 to R68.00 (9.7%).

2.11 CREMATION CERTIFICATES

The previous tariff of R51.00 for the completion of each certificate has been increased to R68.00 (33.3%).

2.12 HOME VISITS

The previous tariff of R43.00 per visit to private-/private-hospital patients remains unchanged. Additional services plus transport must be raised at the revised tariff.

2.13 ORTHOTIC AIDS

The tariffs applicable to orthotic aids have been revised. It also now makes provision for hospital patients in all instances to pay a prescribed contribution towards their orthotic aids, and is payable in advance. In exceptional cases, with the approval of the Medical Superintendent, an account can be raised for the essential aids.

2.14 MORTUARY TARIFFS

The storing of corpses has been increased from the previous tariff of R51.00 to R68.00 (33.3%) per 24 hours or part thereof. Bodies are still kept free of charge for the first 24 hours (public holidays excluded) and 72 hours over weekends. This tariff is applicable only to private-/ private- hospital patients.

3. All private-/private- hospital patients who are still admitted to the hospital as at midnight 31 August 1996 will receive two hospital fees accounts when they are finally discharged. The first account will be raised at the previous tariffs while the second account will be at the revised tariffs.

4. Copies of the following annexures are attached:

4.1 Annexure A : Academic Hospitals : In-Patient Tariffs

4.2 Annexure B : Academic Hospitals : Out-Patient Tariffs

5. Any enquiries in this regard can be directed to the Assistant Director : Hospital Fees, Main Administration Block (Ext. 2206).

MR S FRANCISCUS
DEPUTY DIRECTOR : ADMINISTRATION

SAK/js
(ADMFRANFEESMEM)

Chief Medical Super.		Dep Dir : Nur		Dep Dir : Admin		X	Supersedes/Amends :		Number	Date
Dean of Faculty Medicine		0	1	Medical Admin.		X				
3	Nursing Division	X	2	General Admin.		X				
4	Heads of Departments : Clinical : GSH					X	Key Words : FEES TARIFFS : 1.9.96			
5	Heads of Departments : Clinical : Med. School					X				
6	Heads of Departments : Non-clinical					X	Branch Circular Ref :			
Other :							File Ref : 1.3.39			

Appendix III

STRATMED cc

1st Floor Ella House • 3 Caledonian Road • Mowbray 7700 • Cape Town
Private Bag X4 • Liesbeek 7710
Tel: (021) 685-5146/685-5132 Fax: (021) 686-8833

19 AUGUST 1996

LEIBINGER WURZBURG CONSUMABLE PRICELIST

CAT NO.	DESCRIPTION	GROSS PRICE/EACH
	DRILLS	
LB0108195	TWIST DRILL 1.5MM SHAFT 50MM	188.91
LB0108196	TWIST DRILL 1.5MM SHAFT 50MM	188.91
LB0108198	TWIST DRILL 1.5MM SHAFT 105MM	226.42
	PLATES (1MM)	
LB0108204	BONE PLATE 4 HOLE REGULAR	194.26
LB0108205	BONE PLATE 4 HOLE LONG	194.26
LB0108206	BONE PLATE 6 HOLE REGULAR	206.32
LB0108207	BONE PLATE 6 HOLE LONG	206.32
LB0108208	BONE PLATE 8 HOLE REGULAR	290.73
LB0108216	BONE PLATE 16 HOLE REGULAR	361.74
LB0108230	BONE PLATE L-SHAPE REGULAR RIGHT	318.87
LB0108231	BONE PLATE L-SHAPE REGULAR LEFT	318.87
LB0108232	BONE PLATE L-SHAPE LONG RIGHT	325.56
LB0108233	BONE PLATE L-SHAPE LONG LEFT	325.56
LB0108240	BONE PLATE T-SHAPE REGULAR 90 DEG	361.74
LB0108241	BONE PLATE T-SHAPE LONG 90 DEG	361.74
LB0108248	BONE PLATE DOUBLE T-SHAPE REGULAR	396.57
LB0108250	BONE PLATE Y-SHAPE REGULAR	361.74
LB0108251	BONE PLATE Y-SHAPE LONG	361.74
LB0108260	BONE PLATE DOUBLE Y-SHAPE REGULAR	460.88
LB0108262	BONE PLATE DOUBLE Y-SHAPE LONG	460.88
LB0108234	BONE PLATE L-SHAPE MEDIUM RIGHT	321.54
LB0108235	BONE PLATE L-SHAPE MEDIUM LEFT	321.54
	SCREWS	
LB0108405	BONE SCREW 2MM X 5MM	60.29
LB0108407	BONE SCREW 2MM X 7MM	62.97
LB0108409	BONE SCREW 2MM X 9MM	66.99
LB0108411	BONE SCREW 2MM X 11MM	71.00
LB0108413	BONE SCREW 2MM X 13MM	73.69
LB0108415	BONE SCREW 2MM X 15MM	77.71
LB0108417	BONE SCREW 2MM X 17MM	81.72
LB0108419	BONE SCREW 2MM X 19MM	87.09
LB0108457	BONE SCREW 2.3MM X 7MM	66.99

PERCENTAGE DISCOUNT ON ALL ABOVE PRICES - 15%

PRICES EXCLUDE VAT

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19 AUGUST 1996

LEIBINGER LOW PROFILE CONSUMABLE PRICELIST

CAT NO.	DESCRIPTION	GROSS PRICE/EACH
	DRILLS	
LB6015170	TWIST DRILL 1.5MM SHAFT 70MM	278.92
LB6011170	TWIST DRILL 1.1MM SHAFT 70MM	278.92
	PLATES (0.6MM)	
LB5406104	BONE PLATE 4 HOLES REGULAR	249.20
LB5406112	BONE PLATE 4 HOLES MEDIUM	249.20
LB5406113	BONE PLATE 4 HOLES LONG	249.20
LB5406108	BONE PLATE 6 HOLES LONG	262.59
LB5406109	BONE PLATE 8 HOLES REGULAR	361.74
LB5406124	BONE PLATE L-SHAPE RIGHT	408.63
LB5406125	BONE PLATE L-SHAPE LEFT	408.63
LB5406181	BONE PLATE ORBITA 6 HOLES	458.20
LB5406182	BONE PLATE ORBITA 8 HOLES	458.20
LB5406122	BONE PLATE L RIGHT LONG	408.63
LB5406123	BONE PLATE L LEFT LONG	408.63
LB5406183	BONE PLATE ORBITA 4 HOLES	229.10
LB5406180	NASAL H-PLATE	1011.30
LB5406106	6 HOLE REGULAR	262.59
LB5410195	BLIJDORP 4 HOLE LONG, 6MM SCALE	255.77
LB5410196	BLIJDORP 4 HOLE LONG, 9MM SCALE	267.95
	SCREWS	
LB5215104	BONE SCREW 1.5MM X 4MM	92.44
LB5215105	BONE SCREW 1.5MM X 5MM	92.44
LB5215106	BONE SCREW 1.5MM X 6MM	95.13
LB5215107	BONE SCREW 1.5MM X 7MM	97.80
LB5215108	BONE SCREW 1.5MM X 8MM	99.15
LB5215109	BONE SCREW 1.5MM X 9MM	101.82
LB5220105	BONE SCREW 2MM X 5MM	71.00
LB5220107	BONE SCREW 2MM X 7MM	73.69
LB5220109	BONE SCREW 2MM X 9MM	77.71
LB5223107	BONE SCREW 2.3MM X 7MM (EMERGENCY)	83.07

PERCENTAGE DISCOUNT ON ALL ABOVE PRICES - 15%

PRICES EXCLUDE VAT

Members: Di Pickard, Aat Slot
CK 89/22649/23

STRATMED cc

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Private Bag X4 • Liesbeek 7710
Tel: (021) 685-5146/685-5132 Fax: (021) 686-8833

LEIBINGER 3-D CONSUMABLE PRICELIST

CAT NO.	DESCRIPTION	GROSS PRICE/EACH
	DRILLS	
LB6015142	TWIST DRILL 1.5MM SHAFT 45MM	233.12
LB0108197	TWIST DRILL 1.5MM SHAFT 70MM	209.00
	3 - D (0.6MM)	
LB5406310	2X2 HOLES SQUARE	478.30
LB5406312	2X2 HOLES RECTANGULAR	478.30
LB5406320	3X2 HOLES SQUARE	694.00
LB5406322	3X2 HOLES RECTANGULAR	694.00
LB5406330	4X2 HOLES SQUARE	915.06
LB5406332	4X2 HOLES RECTANGULAR	915.06
LB5406340	4X4 HOLES SQUARE	1359.86
LB5406342	4X4 HOLES RECTANGULAR	1359.86
LB5406360	6X4 HOLES SQUARE	2021.72
LB5406362	6X4 HOLES RECTANGULAR	2021.72
	3 - D (1.0MM)	
LB5410310	2X2 HOLES SQUARE	478.30
LB5410312	2X2 HOLES RECTANGULAR	478.30
LB5410320	3X2 HOLES SQUARE	694.00
LB5410322	3X2 HOLES RECTANGULAR	694.00
LB5410330	4X2 HOLES SQUARE	915.06
LB5410332	4X2 HOLES RECTANGULAR	915.06
LB5410340	4X4 HOLES SQUARE	1359.86
LB5410342	4X4 HOLES RECTANGULAR	1359.86
LB5410360	6X4 HOLES SQUARE	2021.72
LB5410362	6X4 HOLES RECTANGULAR	2021.72
	SCREWS	
LB5220105	BONE SCREW 2MM X 5MM	71.00
LB5220107	BONE SCREW 2MM X 7MM	73.69
LB5220109	BONE SCREW 2MM X 9MM	77.71
LB5223107	BONE SCREW 2.3MM X 7MM (EMERGENCY)	83.07

PERCENTAGE DISCOUNT ON ALL ABOVE PRICES - 15%

PRICES EXCLUDE VAT

Members: DI Pickard, Aat Slot
CK 89/22649/23

Appendix IV

FAX REF NO:
DATE: 21/2/97.
TO:
ATT:
FROM:

MILLNER'S
INCORPORATING
P. GRANT SMITH

HEAD OFFICE
P.O. BOX 1467
CAPE TOWN
8000
SOUTH AFRICA
FAX: (021) 930-5277
TEL. NO: (021) 930-5940

RM LIGATURE WIRE 018 (E-129) @ R34-86 INCL.

Appendix V

Private Bag X12
Tygerberg, 7505
Tel.Add.: UNIBELL, S.A.
Tel. 931-4981

University of the Western Cape

Universiteit van Wes-Kaapland

DEPARTMENT OF MAXILLOFACIAL AND ORAL SURGERY AND RADIOLOGY

Privaatsak X12
Tygerberg, 7505
Tel.Ad.: UNIBELL, S.A.
Tel.: 931-4281

Faculty of Dentistry
Fakulteit Tandheelkunde

Dr. Imo/kn .....

Ref./Verwys. .....

Dear Sir / Madam

RE: PERMISSION FOR THE USE OF CLINICAL RECORDS

As a registrar in the Department of Maxillofacial and Oral Surgery, I am reqired to submit a dissertation in partial fulfillment of the degree MchD at the Faculty of Dentistry, University of the Western Cape.

The topic of my thesis is "A comparison of two modalities of treating single isolated fractures of the mandible"

Your permission is hereby requested for the use of the relevant clinical records. Acknowledgement of your department will be made should any academic papers arise from this study.

Thanking you in anticipation.

Yours sincerely

Dr. V. Rughubar.

Prof. G. Kariem/Dr. R. Lalloo
(Supervisors)