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# SOME PHYSIOLOGICAL CHANGES FOLLOWING INTRRMAXILLARY FIXATION (IMF)

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**A thesis submitted in partial fulfillment for the requirements of the degree of MSc in Oral and Maxillofacial Surgery.**

**May. 2006**

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# 1.1 Dedication

To my loving parents, my whole family and teachers

Elamin

# 1.2 Acknowledgement

*I would like to express my great thanks and respect to Proff. A.M. Sulieman, Dean Faculty of Dentistry, University of Khartoum for his patience, forbearance, and his kind supervision throughout the study, providing me with lots of invaluable information and encouragement giving me the benefit of his experience and knowledge. Actually words fail to express my thanks for the excellent supervision and sincere devotion to my research. I thank him profusely.*

*I would like to acknowledge my indebtedness and thanks to my teachers in the department of oral and maxillofacial surgery who have kindly contributed to my research.*

*My thanks to my colleagues in K.T.D.H.*

*My appreciations and thankfulness are extended to Dr. Ahmed Khalid and Dr. Ahmed Zein for their vital role in typing and printing this thesis.*

*Finally a very thank you to my colleagues "registrars" in the department of oral and maxillofacial surgery in KTDH*

# 1.3 Abstract

In the Sudan as in many countries, patients with fractured jaws following reduction of the fractures, their jaws are usually immobilized by intermaxillary fixation (IMF) for a period of 4-6 weeks. The method is also used for immobilization of the jaws in patients who have undergone orthognathic surgery.

Following inter-maxillary fixation and consequently changes in dietary habits of these patients, many changes in their body composition occur. It is thought that it is worthy to investigate these changes among Sudanese patients and compare them to other published studies.

The material of this study consisted of 30 patients with fractured mandibles who were managed at Khartoum Teaching Dental Hospital in the period December 2004 to June 2005. Of the 30 cases, 28 were male patients with a mean age of 30 years, while the remaining 2 cases were female patients with a mean age of 32 years. Following reduction of the fractures (closed or open), all the patients were immobilized by intermaxillary fixation.

Investigations of the following parameters; 1/body weight, 2/cholesterol level, 3/triglyceride level, 4/total protein level, 5/albumin level, 6/electrolytes {$K^+$ $Na^+$}, and 7/mid arm circumference; were recorded as follows:- a/ on the day of operation ,b /at the end of the 1$^{st}$ post-operative

week, and C/ at the end of the 6th post-operative week.

Our findings showed that 24 patients have a significant reduction in body weight and mid arm circumference, while the remaining 6 patients have gained some weight but it was not significant. The Triglycerides and cholesterol were within the normal physiological levels, though there was a slight increase in the level of the former at the end of the first post-operative week, probably due to changes of dietary habits. Similarly the total protein, albumin, and electrolytes levels showed no significant changes.

The majority of patients suffered different types of complications including insomnia, headache, irritating feelings, anxiety, apnea, temporal pain, trismus, deviation, and sweating.

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# 1.1 Introduction

Trauma is a major cause of admission to hospitals by oral and maxillofacial surgeons. Maxillofacial operations generally compromise the ability to eat or drink in the early postoperative period. Patients undergoing simple dento-alveolar surgery find it uncomfortable to eat normally during the first 24-48 hours, but after that, soon they become able to resume their normal diet [(1)].

Patients with compound or comminuted fractured jaws or who have undergone orthognathic surgery are usually unable to take a normal diet for a period of 6-8 weeks. If healing is to proceed normally in these patients, it is important that all nutritional requirements be met throughout this period, otherwise, these patients may become nutritionally deficient, dehydrated and may develop unwanted complications [(2)].

The jaws are usually immobilized by eyelet wiring or arch bars aided by rubber bands or stainless steel wires for a period ranging between 4-6 weeks. Intermaxillary fixation compromises the nutritional status in the early postoperative period leading to loss of water, fat and protein. The nutritional needs of patients with intermaxillary fixation are sometimes overlooked by health professionals. Individualized nutritional therapy which defines the optimal kilocalories and essential nutrients (carbohydrates, proteins, vitamins, minerals and water) need of the patient is necessary for warding off infection, enhancing healing, and promoting good health [(3)]. Moreover, at one time or another during the immobilization period, it is not uncommon for these patients to express or

display the feeling of pain (due to the fear of chocking), stress or even depression [3].

Ideally, the weight of these patient's should be maintained by providing food in a form of liquid and semi-liquid nature and beverages that are calorically sound [3]. Without adequate nutritional support the energy requirements of these patients are principally met by the breakdown of body protein with a consequent loss of lean body mass and an electrolyte imbalance [4].

Many studies have reported a weight loss as well as electrolyte changes in these patients. This is the first study to be carried in the Sudan and we feel it is worthy to be done putting in consideration the general health of the Sudanese people as well as their nutritional habits.

# 1.2 Literature review

The first description of mandible fractures was as early as 1650 BC, when an Egyptian papyrus described the examination, diagnosis, and treatment of mandible fractures. However; Hippocrates was the first to describe the reapprorximation and immobilization of fractured jaws through the use of circumdental wiring and external bandaging [(5)].

The importance of establishing occlusion was first described in a textbook written in Salerno, Italy, in the year 1180. Maxillofacial fixation first was mentioned in 1492, and till the 19$^{th}$ century most fracture treatment involved some form of external bandage or wrap occasionally used in conjunction with a birdle wire. Currently, the commonest method of immobilization is what we call intermaxillary Fixation (IMF), a technique of different forms set out to link together the natural or artificial teeth of the jaws so as to render the jaw movement impossible. The procedure is also used to maintain correct occlusion temporarily while some forms of direct osteosynthesis are applied. Different methods of intermaxillary Fixation (IMF) have been used; some of them have been proved to be clinically reliable throughout the history of maxillofacial surgery. They include the following:-

1 Arch bar
2 Interdental eyelet wiring
3 Gunning type splints

Intermaxillary fixation (IMF) is also used to enforce a reduction in the quantity and the type of diet for subjects who had previously demonstrated a desire to loose weight [(6)]. Many units have used it either

as primary treatment for obesity or in more recent years as a preparatory treatment mode. Also treatment by inter-maxillary fixation (IMF) had been used to reduce weight prior to later bariatric surgery; as in the case of intestinal bypass or vertical banded gastroplasty [6].

Fat is the main storage form of energy in the body, and it is sensitive to acute malnutrition [4]. After 5 or 6 days of fasting the brain and body adapt to break down free-fatty acids for energy with a relative sparing of lean mass [1]. Body fat is deposited in two major types of storage sites. One for essential lipids, and the other for general fat storage. Essential lipids are found in the bone marrow, central nervous system, mammary glands, and other organs and are required for physiological functioning. Fat from these sites makes up about 9% (4.9Kg) of body weight in the standard woman and 3% (2.1Kg) in the standard man Storage fat consists of inter-and intramuscular fat, which surrounds the organs and gastrointestinal tract [7].

Subcutaneous fat is found under the skin and constitute about one third of all the total body fat. The proportion of storage fat in males and females is relatively constant, and of an average of 12% of total body mass in males and 15% in females [8].

In the semi-starvation normal volunteers, it has been shown that fat and lean body compartments of the tissues shrink, while the extra cellular fluid volume remains either at its pre-starvation state or slightly decreases [2].

Muscles are composed largely of protein, which is the major component of fat-free mass and it serves as an index of the protein reserves of the body. These reserves become depleted during

malnutrition in muscle wasting. Muscle protein assessment can therefore provide an index of the protein reserves of the body. Mid-upper arm circumference and mid-upper arm muscle area are both correlated with measure of total muscle mass and therefore, used to predict changes in total body muscle in mass and hence protein nutritional status [4].

Every protein in the body is functional, and although the protein can be readily broken down, it is not stored as an energy reserve. When consumed in this way, the protein dependent function deteriorates [9, 10].

The arm contains subcutaneous fat and muscles. Decrease in mid-upper arm circumference may therefore reflect a reduction in muscle mass, a reduction in subcutaneous tissue or both. Also changes in mid-upper arm circumference measurement can be used to monitor progress during nutritional therapy, correlating positively with the change in body weight [4].

The fat-free mass is a mixture of water, protein and minerals, with muscle serving as the major protein store [4]. Following trauma or severe surgical stress, the metabolic and endocrine body response become different [9]. The increased production of hormones such as Glucagon , Insulin , Cortisol , Catechloamines , Vasopressin and Aldosterone results in a profound change in protein and energy metabolism [10]. Without adequate nutritional support the energy requirement of these patients are principally met by the breakdown of body protein with a consequent loss of lean body mass [1]. These metabolic changes are clinically manifested by delayed healing, wound infection and prolonged rehabilitation [11].

Potassium (k +) occurs almost exclusively as an intercellular cation, primarily in the muscle and viscera. Negligible amounts occur in

the intercellular fluid, bone or other non-cellular sites. Measurement of total body potassium is therefore used as an index of the fat-free mass in healthy subjects, on the assumption that the fat-free mass has a constant amount of potassium [4].

Potassium (k+) is lost form the cells as protein is catabolized. Consequently the total body potassium may decrease, although the serum potassium concentration may be normal in the catabolic patient, depending on the presence of other sources of loss e.g. urine and diarrhea.

Once re-feeding starts, the cells begin to take up potassium as glycogen and protein are resynthesised. This may result in an abrupt drop in serum potassium concentration [4].

There had been much interest and research into the changes in body composition of the critically ill surgical patients [10], but there is a dearth of research into similar changes sustained by patients undergoing oral and maxillofacial surgery [1].

Many methods are available for estimating body composition, but few are applicable to the clinical environment in which most oral and maxillofacial surgeons work [12]. Arguably, the most accurate of these is in- vivo neutron activation analysis, which requires very expensive equipment and exposes the patient to ionizing radiation [13].

Dual photon X-Ray absorptiometry (DPX) and bioelectrical impedance analysis (BIA), are capable of producing accurate estimates of body composition , but again , they require expensive equipments which are rarely available for routine use [12,14,15].

Fixation of jaws for several weeks is also used in orthognathic surgery, and changes in energy intake and in body weight were reported

in patients following sagital split ramus osteotomies [16].

Jaws wiring of dentate obese patients is an effective way of producing substantial weight loss consistent with safety and maintenance of quality of life [17,18,19]. Lack of teeth presents a relative contra-indication to jaw wiring as placement of fixation and its subsequent maintenance is more difficult [18].

Martin Ritzau studied weight changes in 33 patients with intermaxillary fixation following jaws fractures [20]. The patients were weighed before fixation, which was applied not later than 24 hours after trauma. A second weighing took place on removal of the fixation .The average loss of weight (6.1kg) was greatest in 10 patients with an overweight before fixation, and least (3.4 kg) in 12 patients who were originally underweight. There was no statistically significant difference between the two groups, but there was a distinct tendency towards the overweight having greater loss of weight. The author also showed that there was no statistically significant correlation between loss of weight and the number of days hospitalized, the patients' age and sex or duration of immobilization. [20]

Harju E & Pernu H. studied body weight changes, energy intake and symptoms experienced in 13 patients whose jaws were fixed due to osteotomy for protruding the mandible [16]. All except one patient lost weight and the mean weight loss was 7.5±1:5.3 kg. The weight reduction was higher in the obese patients (11:1:4.2 kg), but also patients of normal weight lost 4.7:1:4.6 kg. The loss of weight was temporary and the patients regained their weights largely or wholly after the fixation period. Ten patients of the 13 felt hunger during the fixation period, two had

abdominal pains, five had constipation and ten had pollacisuria [16]. In 6 of the 13 patients the regaining of weight took place within 6 months and in 2 patients within 3 years. The regaining of weight was not directly related to the loss during the period of fixation, but those who had a minimal reduction of 2 kg regained the weight in a period of two weeks to 3 months and the others in a longer period than this [16].

The patients' weight reduction was in harmony with the reduced energy intake by these patients. The reduction of energy intake per loss of 1 kg of body weight (8.5 = 0.67 mj) corresponded well with the energy content of 1k g of body fat. Loss of weight due to diminished food intake may serve as risk factor for postoperative complications and disturbed wound healing and ossification of the fracture or osteotomy [16].

In 1985 Cawood [21] reported that patients whose mandibular fractures were treated by internal fixation alone lost less weight and regained their preoperative weight faster than those whose fractures were treated by IMF. In his series of 100 cases, the plated group of patients lost less weight (mean 3 kg) in the first postoperative week than the IMF group (mean 5 kg) and had regained their preoperative weight within 4 weeks[21].

Hugh Cannell at the London Hospital Medical College studied the efficiency of metal cap splints and various linkages of immobilization in a group of II patients who had requested restriction from solid diets as a treatment for their obesity [6]. The author found that in 10 patients, 9 were able to tolerate intermaxillary fixation (IMF) by means of cap splints. The weight loss ranged from 9.5 kg in 159 days to 49 kg in 161 days, at an average loss of approximately 0.8 kg/ week[6].

More recently Worral SF [1] studied the post-operative changes in weight and body composition of patients having immobilization by inter-maxillary fixation (IMF) and miniplates osteosynthesis. The study consisted of 22 patients, 13 of them were managed with intermaxillary fixation (IMF) and the remaining 9 patients were treated with miniplates osteosynthesis. The measurements of weight, lean body mass, total body water fat and free lean body mass were recorded, one week and six weeks postoperatively. By the sixth postoperative week, the intermaxillary fixation (IMF) group of patients had lost significantly more weight (4.5kg) than the plated group (1.1 kg). The later weight loss was due to loss of lean body weight (77% water), whereas in the former group, the weight loss resulted from a fat loss of 1.2 kg, plus a lean body mass loss of 3.3kg (73% water). The estimated protein losses were 0.9kg for the intermaxillary fixation (IMF) group and O.3kg for the plated group [1].

The overall mean body weight loss sustained by patients in the above mentioned study was 2.5 kg at 1 week and 3.2 kg at 6 weeks postoperatively. According to the author, patients who were treated with internal fixation alone without IMF lost less weight than patients treated with IMF, but the differences were not as pronounced as in previous study [21].

The weight and body composition changes sustained by patients placed in IMF for 6 weeks are very similar to those sustained by patients who have undergone major abdominal surgery or sustained major blunt trauma[1] Patients managed with IMF are obliged to have a liquidized diet which is often unpalatable, unappetizing and boring. If liquid dietary supplements are prescribed it is also expensive. The cost of 6 weeks

supply of a proprietary nutritional supplement is roughly the same as the cost of two four-holes miniplates and eight screws [22,23].

Sakiano H [24] studied the stress resulting from intermaxillary fixation (IMF) from a biochemical point of view. He measured the levels of urinary 17-hydroeorticosteroids (I7-0HCS) which are metabolites of the hormone cortisol in the urine of patients undergoing intermaxillary fixation (IMF). The findings suggested that urinary 17-0HCS levels reflect the stress related to intermaxillary fixation (IMF), and that such stress mainly causes an irritating feeling. Natural killer cells activity, which is considered to be related to stress, was also measured in these patients. The relationship between natural killer cells activity and the level of 17-0HCS was examined in the study. There was no correlation between the natural killer cells activity and the level of 17 0HCS in the patients, suggesting that natural killer cells activity may not be affected by mechanical stress such as IMF [24].

JG Williams and JI Cawood, UK [25] had carried another study on the effect of intermaxillary fixation (IMF) on the pulmonary function. Seventeen healthy volunteers took part in the study. They were non-smokers and had no evidence of any chest disease. All of them performed normal inspiratory and expiratory exercises through a face mask under conditions of normal airway patency, while teeth in occlusion to simulate the intermaxillary fixation (IMF). The authors measured the forced vital capacity (FVC), the forced expiratory volume (FEV), the ratio FEV/ FVC, and the peak expiratory volume (PEV). They found that occlusion of the teeth in 17 test subjects produced a significant decrease in all measurements but not in the FVC [25].

From the above mentioned studies, it appeared that there is a remarkable influence of inter-maxillary fixation (IMF) on loss of body weight and other changes affecting body composition, including proteins, fats, water, electrolytes and even respiratory gases. Weight loss influences both body composition and the ratio between lean body mass and body fat [26.27]. Along with body fat reduction simultaneous loss of considerable amounts of body proteins has been reported [28,29], leading to signs of malnutrition, such as diminished muscle mass and impaired muscle function [30,31,32].

# 1.3 Aims & Objectives

**General objective:**

To study the changes in body composition following inter-maxillary fixation

**Specific objectives:**

1 To study the effect of inter-maxillary fixation (IMF) on body weight and mid arm circumference

2 To investigate the changes following inter-maxillary fixation in the physiological levels of cholesterol, triglycerides, electrolytes, total protein and albumin.

3 To compare our study with similar published studies

# 2.1 Materials & Methods

The material consisted of 30 Sudanese patients with fractured mandibles. The patients were managed at Khartoum Teaching Dental Hospital in the period December 2004 to June 2005. Twenty eight ((93.3%) cases were male patients and 2 cases (6.7%) were female patients. The patients age ranges from 18 to 50 (see table 1). The diagnosis of the fracture was made from -

1. History
2. Clinical examination:-
3. Radiography interpretation:

All the patients were admitted to the hospital on the day of arrival and operated-on within the 1st week of admission. Four patients were treated by open reduction of the fracture and then immobilized by IMF using arch bars. The remaining 26 cases were treated by closed reduction and immobilized by IMF using also arch bars. The IMF was kept for up to six weeks. In 3 cases of the latter group, elastic bands were used to correct some remaining occlusal derangement.

The following parameters:-

1. Body weight:
2. Cholesterol level:
3. Triglyceride level :

4. Total protein:
5. Albumin:
6. Serum K+:
7. Serum Na+:
8. Mid-arm circumference:

***Were recorded 3 times as follows:-***

A/ on the day of operation pre-operatively

B/ on the last day of the 1ist week post-operatively

C/ on the last day of the $6^{th}$ week post-operatively

# 3.1 Results

Of the 30 patients managed, 28 were male patients (93.3%) with a mean age of 30 years, and the remaining 2 cases were female patients (6.7%) with a mean age of 32 years ( table 1& 2).

Twenty four patients showed a decrease in weight by the end of the inter-maxillary fixation period (table 3), while the remaining 6 showed a decrease in body weight by the end of the first week , and an increase in the body weight by the end of the $6^{th}$ week (table 4 ). The whole sample showed a decrease in body weight following immobilization by inter-maxillary fixation (table 5)

There was a decrease in the cholesterol level by the end of the $1^{st}$ week, while there was an increase in the cholesterol level by the end of the six week (table 6).

The triglycerides showed an increase in the levels by the end of the first week and a decrease in the level by the end of the $6^{th}$ week of inter-maxillary fixation (table 7).

Both sodium and potassium showed a decrease during the 2 periods (table 8&9).

Table 10&11 show a decrease in the total protein level in both periods, and an increase level of the albumin in both periods. Table 12 shows a decrease in mid arm circumference in both periods.

Many of the complications were seen among these patients: - 12 patients had a state of insomnia, 16 patients felt headache and also 16 had irritable feelings, 6 patients experienced anxiety, 3 patients suffered apnea. One patient suffered from a temporal pain, one patient had trismus, and one patient suffered abnormal sweating (table 13).

## Table (1): Age Statistics

| Statistics | Age Distribution |
|---|---|
| *N* | 30 |
| *Mean* | 29.6833 |
| *Median* | 25.5000 |
| *Mode* | 21.00 |
| *Std deviation* | 10.3861 |
| *Minimum* | 18.00 |
| *Maximum* | 50.00 |

## Table (2): Age Statistics according to gender

| Statistics | Males | Females |
|---|---|---|
| | 28 | 2 |
| *an* | 29.5 | 32.25 |
| *dian* | 25.5 | 32.25 |
| *de* | 21 | 19.5 |
| *deviation* | 10.16 | 18.03 |
| *ıimum* | 18 | 19.5 |
| *ximum* | 50 | 45 |

## Table (3): Body weight Statistics (Decrease group)

| | Body weight | | |
|---|---|---|---|
| **Statistics** | Day of operation | 1st week | 6th w |
| N Valid | 24 | 24 | 24 |
| Missing | 0 | 0 | 0 |
| Mean | 55.6250 | 54.9583 | 51.93 |
| Median | 54.7500 | 53.5000 | 50.00 |

| | | | |
|---|---|---|---|
| mode | 71.00 | 71.00 | 53.00 |
| Std Deviation | 8.7293 | 8.8820 | 8.744 |
| Minimum | 41.00 | 40.50 | 38.00 |
| Maximum | 71.00 | 71.00 | 68.00 |

**Table (4): Body weight statistics** (Increase group)

| Body Weight | | | |
|---|---|---|---|
| **Statistics** | **Day of Operation** | **1st Week** | **6th Week** |
| *N* | 6 | 6 | 6 |
| *Mean* | 55.3333 | 55.2500 | 56.6667 |
| *Median* | 56.7500 | 55.2500 | 57.5000 |
| *Mode* | 43.50 | 46.00 | 48.00 |
| *Std Deviation* | 7.6659 | 7.646 | 6.648 |
| *Minimum* | 43.50 | 46.00 | 48.00 |
| *Maximum* | 65.00 | 66.00 | 66.00 |

**Table (5): Body weight** (Whole sample)

| Body Weight | | | |
|---|---|---|---|
| **Statistics** | **Day of Operation** | **1st Week** | **6th Week** |
| *N* | 30 | 30 | 30 |
| *Mean* | 55.567 | 55.0167 | 52.8833 |
| *Median* | 55.0000 | 53.5000 | 52.0000 |
| *Mode* | 71.00 | 46.00 | 53.00 |

| | | | |
|---|---|---|---|
| *Std Deviation* | 8.4013 | 8.4664 | 8.4829 |
| *Minimum* | 41.00 | 40.50 | 38.00 |
| *Maximum* | 71.00 | 71.00 | 68.00 |

**Table (6): Cholesterol level Statistics**

*(Normal level up to 200mg/dl)*

| Cholesterol Level | | | |
|---|---|---|---|
| **Statistics** | **Day of Operation** | **1st Week** | **6th Week** |
| *N* | 30 | 30 | 30 |
| *Mean* | 126.6667 | 124.7333 | 130.1667 |
| *Median* | 121.5000 | 126.0000 | 126.0000 |
| *Mode* | 81.00 | 96.00 | 11.00 |
| *Std Deviation* | 35.5221 | 30.9214 | 38.2479 |
| *Minimum* | 70.00 | 60.00 | 60.00 |
| *Maximum* | 202.00 | 199.00 | 213.00 |

**Table (7): Triglyceride level Statistics**

*(Normal sus fr. 150mg/dl-incr. fr. 200mg)*

| Triglyceride Level | | | |
|---|---|---|---|
| **Statistics** | **Day of Operation** | **1st Week** | **6th Week** |

| | | | |
|---|---|---|---|
| *N* | 30 | 30 | 30 |
| *Mean* | 85.3000 | 92.9333 | 83.9667 |
| *Median* | 87.5000 | 86.5000 | 77.0000 |
| *Mode* | 50.00 | 50.00 | 50.00 |
| *Std Deviation* | 25.0147 | 28.7593 | 29.8346 |
| *Minimum* | 40.00 | 50.00 | 38.00 |
| *Maximum* | 127.00 | 165.00 | 154.00 |

**Table (12): Mid arm circumference Statistics**

| Mid Arm Circumference | | | |
|---|---|---|---|
| **Statistics** | **Day of Operation** | **1st Week** | **6th Week** |
| *N* | 30 | 30 | 30 |
| *Mean* | 24.3567 | 24.3500 | 23.9333 |
| *Median* | 24.0000 | 24.0000 | 23.5500 |
| *Mode* | 24.00 | 24.00 | 23.00 |
| *Std Deviation* | 2.0890 | 2.0634 | 2.0555 |
| *Minimum* | 19.00 | 19.00 | 18.60 |
| *Maximum* | 28.90 | 28.90 | 28.20 |

**Table (13): Complications (Statistics)**

| Type of treatment | | | |
|---|---|---|---|
| **Complication** | **Closed reduction** | **Open reduction** | **Total** |
| Insomnia | 11 | 1 | 12 |
| Headache | 14 | 2 | 16 |
| Irritation feeling | 14 | 2 | 16 |
| Anxiety | 6 | 0 | 6 |
| Apnea | 3 | 0 | 3 |
| Temporal pains | 1 | 0 | 1 |
| Trismus | 1 | 0 | 1 |
| Slight deviation | 1 | 0 | 1 |
| Sweating | 1 | 0 | 1 |

## Table (8): Sodium level Statistics

*(Normal level 133 – 148 mmol/L)*

| Serum Sodium Level | | | |
|---|---|---|---|
| **Statistics** | **Day of Operation** | **1st Week** | **6th Week** |
| *N* | 30 | 30 | 30 |
| *Mean* | 135.0000 | 134.9667 | 134.2000 |
| *Median* | 135.0000 | 135.5000 | 135.0000 |
| *Mode* | 130.00 | 136.00 | 136.00 |
| *Std Deviation* | 4.0599 | 3.7827 | 4.3660 |
| *Minimum* | 130.00 | 130.00 | 125.00 |
| *Maximum* | 146.00 | 145.00 | 143.00 |

## Table (9): Potassium level Statistics

*(Normal level 3.5 – 5.0 mmol/L)*

| Serum Potassium Level | | | |
|---|---|---|---|
| **Statistics** | **Day of Operation** | **1st Week** | **6th Week** |
| *N* | 30 | 30 | 30 |
| *Mean* | 3.7767 | 3.6567 | 3.6133 |
| *Median* | 3.6500 | 3.6000 | 3.6000 |
| *Mode* | 3.50 | 3.50 | 3.30 |
| *Std Deviation* | .4108 | .4256 | .5728 |
| *Minimum* | 3.20 | 2.60 | 1.40 |
| *Maximum* | 4.80 | 4.30 | 4.30 |

## Table (10): Protein level Statistics

*(Normal level 6.0 – 8.0 g/dl)*

| Total Serum Protein Level | | | |
|---|---|---|---|
| **Statistics** | **Day of Operation** | **1st Week** | **6th Week** |
| *N* | 30 | 30 | 30 |
| *Mean* | 6.9333 | 6.9167 | 6.8967 |
| *Median* | 6.8500 | 6.8000 | 6.8500 |
| *Mode* | 6.60 | 6.30 | 6.60 |
| *Std Deviation* | .4859 | .4814 | .5654 |
| *Minimum* | 6.10 | 6.30 | 5.70 |
| *Maximum* | 7.80 | 7.90 | 7.80 |

## Table (11): Albumin Statistics

*(Normal level 3.5 – 5.0 g/dl)*

| Serum Albumin Level | | | |
|---|---|---|---|
| **Statistics** | **Day of Operation** | **1st Week** | **6th Week** |
| *N* | 30 | 30 | 30 |
| *Mean* | 4.2967 | 4.3200 | 4.3100 |
| *Median* | 4.3000 | 4.4000 | 4.3500 |
| *Mode* | 4.20 | 4.00 | 4.20 |
| *Std Deviation* | .4030 | .3517 | .3898 |
| *Minimum* | 3.40 | 3.30 | 3.40 |
| *Maximum* | 5.10 | 4.80 | 5.00 |

## Table (12): Mid arm circumference Statistics

| Mid Arm Circumference | | | |
|---|---|---|---|
| **Statistics** | **Day of Operation** | **1st Week** | **6th Week** |
| *N* | 30 | 30 | 30 |
| *Mean* | 24.3567 | 24.3500 | 23.9333 |
| *Median* | 24.0000 | 24.0000 | 23.5500 |
| *Mode* | 24.00 | 24.00 | 23.00 |
| *Std Deviation* | 2.0890 | 2.0634 | 2.0555 |
| *Minimum* | 19.00 | 19.00 | 18.60 |
| *Maximum* | 28.90 | 28.90 | 28.20 |

## Table (13): Complications (Statistics)

| Type of treatment | | | |
|---|---|---|---|
| **Complication** | **Closed reduction** | **Open reduction** | **Total** |
| Insomnia | 11 | 1 | 12 |
| Headache | 14 | 2 | 16 |
| Irritation feeling | 14 | 2 | 16 |
| Anxiety | 6 | 0 | 6 |
| Apnea | 3 | 0 | 3 |

| | | | |
|---|---|---|---|
| Temporal pains | 1 | 0 | 1 |
| Trismus | 1 | 0 | 1 |
| Slight deviation | 1 | 0 | 1 |
| Sweating | 1 | 0 | 1 |

# 4.1 Discussion

Recently in the Sudan Nasir carried a study on the prevalence of maxillofacial trauma in the country [33]. The author found the common cause of maxillofacial trauma was assault acounting for 52% followed by road traffic accident accounting for 31%. cHe showed the mandible as the commonest site for fractures. These fractures were distributed as follows: 30% were parasymphysial fractures, 30% were body fractures, 22% were angle fractures, 9% were symphysial fractures, and 6% were condylar fractures. The author carried the study at Khartoum Teaching Dental hospital, where the fractures were treated, and the sole method for immobilization of these fractures was inter-maxillary fixation [33].

Not many studies were carried on the effects of intermaxillary fixation, and the little published on the subject is not very new. The use of miniplates and rigid fixation in the management of fractured mandibles had negated or obviated the use of intermaxillary fixation as an absolute method of immobilization in many countries. However, despite the wide use of miniplates, intermaxillary fixation is still used as the sole and only method of immobilization in many parts of the world. Sudan is one of those countries where the art of miniplating and rigid fixation is not yet in practice, and the only method used for immbolization of fractured mandibles is intermaxillary fixation.

Intermaxillary fixation (IMF) enforces a reduction in the quantity and quality of diet and compromises the patient ability to eat during the whole period while the jaws are fixed together. The method subjects the patient to stress and abnormal behavior towards the new life by impeding speech and mastication. Diminished energy intake induces weight loss with subsequent changes in body composition and muscles.

The few papers published on the effects of inter-maxillary fixation on patients had addressed mainly the changes in body weight and mid-arm circumferences. In this study in addition to the body weight and mid-arm circumference, we have also investigated the serum levels of cholesterol, triglycerides, potassium, sodium, total protein and albumin. To our knowledge no study had investigated the changes in these parameters before, during, and after inter-maxillary fixation.

### 4.1.1 The Body weight

With regards to the body weight apparently there were two groups; group I which encompassed 24 patients showed a decrease in body weight during the end of the 1st week. The reduction in the mean body weight was 0.7kg (55.62-54.96) which is statistically significant. The reduction in the mean body weight during the whole period of intermaxillary fixation was 3.7kg (55.63-51.94) which is a highly significant change (table 3).

Group II (the remaining 6 pts) showed an insignificant decrease in body weight equal to 0.1kg (55.3-55.2) after the 1st week, but at the end of the six post-operative week they showed an insignificant increase in body weight of an average of 1.3 kg (table 4). Considering the whole sample the reduction in body weight was significant at the end of both the 1st post-operative week 0.4kg (55.6-55) and the six post-operative week 2.7kg (55.6-52.9) (table 5).

Similar findings were showed before by E. Harju, who studied the body weight changes in 13 patients following intermaxillary fixation. He reported that all of them except one had lost weight with a mean weight loss of 7.5 ± 3.5 kg. Also SF Worral in a study done on 2 groups of patients with (plated) and without IMF (non-plated), showed a significant difference in body weight between the two groups. He reported a reduction of 4.5 kg in the non plated group compared to a reduction of 1.1 kg in the plated group. From these studies it is obvious that intermaxillary fixation (IMF) compromises the nutritional status of the patients and leads to a significant loss of weight. In this study, the increase in body weight in 6 of our patients after the six post-operative weeks can be attributed to the fact that the Sudanese have certain traditional behavior towards their patients. They tend to supplement the hospital food with home –made food and soft drinks. These soft drinks are usually very sweety and because of the hot climate of the country the

Sudanese drink them excessively and very frequently.

## 4.1.2 Triglycerides:

Hypertriacylglycerolaemia usually occurs when dietary fat is reduced and replaced by carbohydrate diet that may lead to *De novo* lipogenesis [34]. The phenomenon of carbohydrate induced hypertriacylglycerolaemia has led some scientists to conclude that these diets may not provide net benefit to health [35,36]. It is clear that some elevation in fasting TAG will occur in almost all subjects who lower their dietary fat. Increasing the carbohydrate content of the diet has been shown to increase blood triglyceride concentration through many mechanisms, including elevations in fatty acid synthesis and very low density lipoprotein (VLDL)-TAG secretion and also through reduced VLDL-TAG clearance [34].

In this study, by the end of first post-operative week there was a significant increase in the level of triglycerides of 7.6mg, but by the end of the sixth post-operative week the reduction in the level of the triglycerides was small and not significant 1.3mg (table 7).

When we compare our findings with those of Elizabeth J Parks [34]. and those of Watkins in the early 1950s [37] they are more or less similar to each others. The same findings were reported by Gambera and his

colleagues in 1995 [38] and by Ortega and Andres in 1994 [39], and more recently in the year 2000 by Park's and Hellerstein who showed that when individuals are advised for health reasons to lower their dietary fat intake, the cholesterol content of the diet is reduced, and the subject losses weight [40].

## 4.1.3 Cholesterol:

With regard to the cholesterol level our findings showed that there is no significant change at the end of the first post-operative week (126.6667-124.7333, P>0.05) as well as at the end of the six post-operative week (126.6667-130.1667, P>0.05) (table 6). Hallak and Nomani in their study on the effects of fasting found an increased blood cholesterol level with weight loss during the fasting month of Ramadan[41].

Other investigators (Fedail et al [42], Shoukry [43] and El Arnaoty and Johnson [44] also noted an increased level of blood cholesterol with weight loss. On the other hand Maislos et al showed that during Ramadan, when no significant difference was noticed in blood cholesterol levels before and after fasting period, there was no significant difference in body weight as well [45].

Here in our study we observed that there was no significant change

in blood cholesterol level during the period of IMF, although there was a significant loss of weight in these patients.

## 4.1.4/4.1.5 Total proteins & Albumin:

The fourth and fifth parameters investigated, were the total serum protein and serum albumin (table 10,11).

Total serum protein level is used as an index of visceral protein status in general nutritional surveys [46]. Reduction in many serum protein levels arising from stress occur frequently in critically ill hospital patients. In Marasmus there is no change in serum albumin despite there is deficits in weight. In this study we did not find any significant change in the levels of either total serum protein or serum albumin during and after the intermaxillary fixation period (p-value >0.05).

## 4.1.6/4.1.7 Electrolytes (Sodium & Potassium):

Although it is expected to have some changes in the electrolytes ($K^+$&$Na^+$) levels during the 1st 48 hours following trauma or surgery, we thought it might be worthwhile to see if there is any change afterwards in the serum levels of these elements that might be induced by the compromised nutritional and fluid intake of these patients having IMF. Our findings showed no significant changes in both periods

, i.e. at the end of the 1st week as well at the end of the six post-operative week (table 8,9). Unfortunately we failed to get any study on the subject for comparison.

## 4.1.8 Mid arm circumference:

Mid arm circumference measurement, is usually taken at a mid point of the upper left arm between the acromion process and the tip of the olecranon. It reflects a reduction in muscle mass, a reduction in subcutaneous mass or both. In this study we found that there was no significant reduction in mid-arm circumference in the first period but in the second period there was a reduction in mid arm circumference which correlates with the decrease in body weight (table 12). This is similar to many studies published before [47,48,49]. These changes in mid upper arm circumference measurements can be used to monitor progress during nutritional therapy, as they correlate positively with changes in body weight.

## 4.1.9 Complications:

Patients during the period of IMF experienced a lot of complications. Twelve out of 30 experienced insomnia during the course

of treatment. Sixteen complained of headache and 16 came with irritating feelings. Six were anxious, and 3 experienced difficulty in breathing with short breathlessness. One patient complained of temporal pain. One patient came post-operatively after two weeks complaining of limitation of mouth opening and another one came with posterior cross-bite and deviation towards the fractured side. And lastly one patient complained of sweating (table 13).

The above mentioned complications were also reported by E. Harju and H. Perwi. They appeared to be due to the psychological imbalance or trauma which occurred to the patient as he experienced a new type of life, with restriction in the quantity and quality of dietary intake, as well as in communication.

# 4.2 Conclusion

Intermaxillary fixation comprises the feeding and hence the patients loose weight. In this study the majority of the patients lost weight significantly, but some patients (20%) gained little weight which was not significant.

The cholesterol level and triglycerides showed no significant changes between the pre-operative readings and the post-operative findings.

The electrolytes ($K^+$, $Na^+$) showed no significant change.

The mid arm circumference was decreased by end of the IMF period and I correlated positively with the changes in body weight.

During the period of IMF the majority of patients experienced a lot of complications including: - Insomnia (12 pts), headache (16 pts), irritating feelings (16 pts), anxiety (6 pts), apnea (3 pts), temporal pains (1 pt), trismus (1 pt), slight deviation (1 pt), and sweating (1 pt)

# 4.3 Recommendations

- Intermaxillary fixation (IMF) should be replaced by rigid fixation e.g. plating system
- If we apply IMF, nutritional supply should be maintained during the period of fixation
- Avoid stressful conditions during fixation period to reduce side effects
- Maintenance of good oral hygiene during the period of IMF
- Regular follow up to the patients during and after IMF

Questionnaire

# University of Khartoum
# Faculty of Dentistry
# Department of Oral Surgery

## Body composition changes following intermaxillary fixation (IMF)

1- Patient's name:_____

2- Age: ☐☐

3- Gender: 3.1 Male 3.2. Female

4- Occupation: ……

5- Telephone number: ……

6- Tribe:

7- Chief complain: …….....

8- On examination: …….....

9- Investigations: 9.1. X-ray 9.2. C.T

10- Diagnosis: ……

11- Type of fracture/fractures: ……

12- Treatment plan :……

13- Preoperative parameters (on the day of intermaxillary fixation):
13.1. Body weight
13.2. Cholesterol
13.3. Triglycerides
13.4. Serum electrolytes (Sodium and potassium)
13.5. Total body protein + albumin
13.6. Mid arm circumference

14- One week following intermaxillary fixation (IMF):
14.1. Body weight
14.2. Cholesterol
14.3. Triglycerides
14.4. Serum electrolytes (Sodium and potassium)
14.5. Total body protein + albumin
14.6. Mid arm circumference

15- Six weeks after intermaxillary fixation:
15.1. Body weight
15.2. Cholesterol
15.3. Triglycerides
15.4. Serum electrolytes (Sodium and potassium)
15.5. Total body protein + albumin
15.6. Mid arm circumference

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