Original Research Article

Evaluation of anthropometric indices in patients with maxillomandibular fractures undergoing intermaxillary fixation

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ARTICLE INFO

ABSTRACT

Intermaxillary fixation affects the anthropometric measurements like body mass index (BMI) and skin fold thickness with possible changes in lipid and total protein profile while promoting loss of water, protein and fat. This study aims to determine the effect of IMF on BMI and skinfold thickness. Changes in the physiological levels of total protein, albumin, lipid profile factors and calcium were also assessed. It was a cross sectional study in patients with maxillomandibular fractures conducted at the Department of Oral and Maxillofacial Surgery, Government Dental College, Thiruvananthapuram, Kerala, India. BMI and skinfold thickness was recorded before and after the 4-week IMF period in 45 patients. SPSS software version 20.0 was used. Categorical and quantitative variables were expressed as frequency and mean +/- SD respectively. Paired t test was used on certain quantitative parameters. $p < 0.05$ was considered significant. This study showed that treatment with IMF can lead to changes in anthropometric indices namely BMI and skin fold thickness and possible change in total protein and albumin.

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1. Introduction

Nutrition is a highly critical factor in the healing process, and IMF affects the anthropometric measurements like body mass index (BMI) and skin fold thickness with possible changes in lipid and total protein profile while promoting loss of water, protein and fat. Malnutrition is associated with losing more than 10% of body weight, neurologic changes, skin changes, subcutaneous fat volume, loss of hair, reduction of serum proteins and lipids and loss of muscle mass.[1] This study evaluated the effect of IMF on BMI and skinfold thickness, and thus assessed patient nutrition.

The aims and objectives of the study were

1. To determine the effect of intermaxillary fixation on the anthropometric indices namely BMI and skinfold thickness in patients with maxillomandibular fractures.
2. To determine and compare the changes following intermaxillary fixation in the physiological levels of total protein, albumin, lipid profile factors [serum total cholesterol (TC), low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglyceride (TG)] and calcium.

2. Materials and Methods

It was a cross-sectional study conducted over 18 months, conducted at the Department of Oral and Maxillofacial Surgery, Government Dental College, Thiruvananthapuram, Kerala, India. All consecutive patients reporting to the outpatient department, with maxillomandibular

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fractures meeting eligibility criteria, were included until the sample size was obtained. Permission from the Institutional Ethics Committee was obtained. (IEC/R/10/2018/DCT/dated/20/12/2018)

2.1. Inclusion criteria

1. 15-60 years of age
2. BMI 18-30
3. Patients in need of treatment with IMF for mandibular and maxillary fractures

Medically compromised patients, edentulous patients, pregnant and lactating mothers were excluded.

2.2. Sample size (N) calculation

$$N = \frac{2\,(Z\alpha + Z\beta)2\,\sigma2}{\Delta^2}$$

Where
$Z\alpha = 2.58$ for $\alpha = 0.01$
$Z\beta = 1.64$ for $\beta = 0.05$
$\Delta = \mu T - \mu C$ (difference in mean) σ
= Standard deviation
BMI was used to calculate sample size
Before IMF mean=23.11
After IMF mean=22.53
Δ= 0.58
Standard deviation=0.92,
N=44.6 hence taken as 45

2.3. Outcome measures

1. Age
2. Gender
3. Body weight and height
4. BMI
5. Skin fold thickness
6. Total cholesterol TC)
7. Low density lipoprotein (LDL)
8. High density lipoprotein (HDL)
9. Triglyceride (TG)
10. Albumin
11. Total protein
12. Calcium

2.4. Procedure

BMI and skinfold thickness were recorded before and after the 4 weeks IMF period. The formula for calculating BMI was Weight (kg)/ Height(m). Skinfold thickness was measured at the right triceps at the posterior surface of the arm, midway between the shoulder(acromion) and the elbow (olecranon).

Using the forefinger and the thumb the assessor grasped and lifted the subcutaneous tissue and skin at the triceps site. The pincers of the skin-fold caliper were placed at the triceps point at a depth of 1cm and held in this position for 3- 4 seconds. Three measurements were taken for accuracy. The calipers provided the actual skin-fold thickness in millimeters.

The blood samples were obtained from all patients before treatment for total protein, albumin, lipid profile factors and calcium. All parameters were redone at the same laboratory using the same standardization which were used for measurements before placement of IMF. None of the patients received any commercial nutritional supplements during the treatment period, and high protein liquid diet was advised.

2.5. Statistical analysis

1. Statistical analyses were performed by using the statistical package for social science (SPSS) software version 20.0.
2. Categorical and quantitative variables were expressed as frequency (percentage) and mean ± SD respectively.
3. Paired t test was used for the evaluation of the effect of IMF on selected quantitative parameters.
4. $p<0.05$ was considered the threshold for statistical significance.

Among the 45 patients selected for study, 42 (93.3%) were male and 3 (6.7%) patients were female.

3. Results

Effect of (IMF) on weight, BMI, skinfold thickness, mean albumin value and mean total protein value.

3.1. Weight

The mean weight of 68.8 ± 6.6kg before IMF and weight was reduced to 65.4±6.4 after IMF with a mean difference of 3.4 which was found to be statistically significant. (Table 1)

Table 1: Effect of IMF on weight

Weight	Mean	SD	N	Mean Difference	Paired t	P
Before	68.8	6.6	45	3.4	13.59	p<0.01
After	65.4	6.4	45			

3.2. BMI

The BMI was 25 ±1.7 before IMF and after 4 weeks of IMF, it was 23.8 ±1.7 with a mean difference of 1.3 at the end of treatment and these changes were statistically significant. (Table 2)

Table 2: Effect of IMF on BMI

BMI	Mean	SD	N	Mean Difference	Paired t	p
Before	25.1	1.7	45	1.3	13.47	p<0.01
After	23.8	1.7	45			

3.3. Skin fold thickness

The mean skinfold thickness at the triceps before IMF was 15.2±1.7mm and after 4 weeks of IMF it reduced to 13.9±1.6mm with a mean difference of 1.3mm which was statistically significant. (Table 3)

Table 3: Effect of IMF on skin fold thickness

Skin fold thickness	Mean	SD	N	Mean Difference	Paired t	P
Before	15.2	1.7	45	1.3	9.6	p<0.01
After	13.9	1.6	45			

3.4. Mean albumin value

The mean albumin value before IMF was 4.7±0.5gm% and after 4 weeks it reduced to 4.5±0.5gm% with a mean difference of 0.3mg% which was statistically significant. (Table 4)

Table 4: Effect of IMF on mean albumin value

Albumin	Mean	SD	N	Mean Difference	Paired t	p
Before	4.7	0.5	45	0.3	7.82	p<0.01
After	4.5	0.5	45			

3.5. Mean total protein value

The mean total protein was 7±0.5gm% and after four weeks of IMF it reduced to 6.6±0.5gm% with a mean difference of 0.4gm% which was statistically significant. (Table 5)

Table 5: Effect of IMF on mean total protein value

Total protein	Mean	SD	N	Mean Difference	Paired t	p
Before	7.0	0.5	45	0.4	8.78	p<0.01
After	6.6	0.5	45			

4. Discussion

Following trauma, the metabolic and endocrine body response gets altered.[2] Increased production of glucagon, insulin, cortisol, catecholamines, vasopressin and aldosterone results in a profound change in protein and energy metabolism.[3] Without adequate nutritional support the energy requirements of these patients are primarily met by the breakdown of body proteins with a consequent loss of lean body mass.[4] These metabolic changes are clinically manifested by delayed healing, wound infection and prolonged rehabilitation.[5]

The assessment of nutritional status using anthropometry is done by a range of methods which vary in their practicality, validity and the ability to identify malnutrition. These variables include height, weight, body mass index and alternative indices, trunk measurements (waist and hip circumferences and sagittal abdominal diameter) and limb measurements (mid-upper arm and calf circumferences) and skinfold thickness. Measurement of subcutaneous fat using skinfold calipers allows body fat to be estimated and thereby evaluation of muscle stores. The procedure is quick, requires noncomplex portable equipment and thus can be undertaken in most clinical settings.[6]

The measurement of skinfold thickness has been proposed as a useful technique for evaluating body fat. The circumferences of the biceps, chest, waist, iliac crest and thigh along with skinfolds over the triceps, biceps, subscapular, suprailiac and knee can be used to assess weight loss.[7]

Among the 45 patients, 42, (93.3%) were male and 3 (6.7%) patients were female with a mean age of 30 ± 8.6 years. These results corresponds to the study of Yazdani et al.,[1] Elamin[8] and Farooq et al.[9] in which the mean age of subjects were 30 years.

According to Yazdani et al.[1] the patients had an average weight loss of 2.64 kg during 4 weeks of IMF, which was expected due to the lack of consumption of normal diet. Worral SF[10] treated two groups of patients, one with open reduction and rigid internal fixation sans IMF and the second group without open reduction and rigid internal fixation, and reported a reduction of 4.5 kg in patients without open reduction and IMF group compared to a reduction of 1.1 kg in the open reduction group. Elamin[8] showed a reduction in the mean body weight during the 6-week period of intermaxillary fixation (3.7kg) which is a highly significant change. The weight loss seen in this study can be comparable to other studies and it had almost the same pattern of reduction. Since the weight loss did not reach 10% in this study, we can assume that treatment with IMF will not result in obvious and severe malnutrition. As the patient's height remained the same during the study, with the reduction of the patient's weight, BMI also decreased.

Yazdani et al. opined that the skinfold thickness at the triceps muscle decreased significantly (p= 0.011) (approximately 0.7 mm) during treatment. They evaluated skinfold thickness and body mass index (BMI) in 60 patients who were treated with a 4-week period of IMF. The weight, BMI and skinfold thickness decreased significantly during (p < 0.01). IMF led to mild to moderate malnutrition in some cases, making it necessary to use nutritional supplements.[1] Worall SF[4] assessed the skinfold thickness at 4 points of

the body and showed decrease after IMF. Antilla et al[11] reported a decrease in skinfold thickness but the changes in their study were not statistically significant. In this study there was a statistically significant decrease in skin fold thickness.

A mean difference of 0.3 gm% was observed after 4 weeks of IMF in albumin value in this study. Albumin is a long term index for malnutrition, its half-life is of 20 days, and so that short term changes don't affect it. The IMF period in this study was 28 days, so albumin will be a suitable parameter to show the patient's nutrition condition. There was a significant decrease in the patient's albumin level due to treatment with IMF although this reduction was not severe, it showed the insufficient nourishment. According to Farooq et al[9] it was seen that the mean value of albumin, faced a reduction of 0.43 mg/dl during the 4 weeks of IMF period and was statistically significant. The result is almost similar to this study. Elamin[8] did not find any significant change in the levels of either total serum protein or serum albumin during and after the intermaxillary fixation period ($p > 0.05$).

The mean cholesterol value before IMF was 175.3 ± 16 mg% and after 4 weeks of IMF was 175 ± 15.2 mg%. Farooq et al.[9] assessed the mean total cholesterol level before the treatment as 157.53 ± 27.76 mg/dl which reduced to 154.53 ± 28.27 mg/dl at the end of treatment. Yazdani et al.[1] found that the mean total cholesterol value of patients at the starting point of the study was 154.67 mg/dl which decreased to 152.15 mg/dl after 4 weeks of IMF period ($p = 0.420$). These results coincide with this study.

Sheet & Hassouni studied 2 groups, the first group included 25 trauma patients and the second group included 7 obese volunteers on 6 weeks IMF. Changes of the anthropometric measurements, body mass index, serum K+ and serum albumin were statistically highly significant in trauma patients with body weight loss ranging between (5-8 kg). They concluded that IMF compromises the nutritional status of the patients leading to loss of water, fat and protein in both groups but the effect was more pronounced in traumatized patients due to hormonal and metabolic response to trauma together with the limited oral intake.[12]

Kondo et al. treated 25 patients for mandibular fractures by IMF with NST intervention, who were used as the primary group, and 25 patients treated without nutrition support teams (NST) intervention, who were used prospectively as a control group. The body weight loss of patients with NST intervention was significantly lower. In the first group, a significant decrease of albumin, C reactive protein and significant increase of energy sufficiency was found. NST intervention was highly effective for maintaining nutritional status and body weight during the IMF period.[10]

Christensen concluded that during the course of treatment for mandibular fractures, patients experienced moderate weight loss, indicating a decline in their nutritional status.[13]

5. Conclusion

This study showed that treatment with IMF can lead to changes in anthropometric indices namely BMI and skin fold thickness and possible changes in total protein and albumin. So treatment with IMF can result in malnutrition, although not severe. Nutrition is a key factor for fast and better fracture and wound healing it is advisable to monitor selected blood parameters, which can serve as a guide to nutritional supplementation.

6. Source of Funding

7. Conflict of Interest

None.

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