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Weight Changes in Mandibular Fracture Patients After Maxillomandibular Fixation

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ABSTRACT

Maxillofacial injuries, frequently caused by accidents or violence, often result in mandibular fractures. Treatment options include open and closed reduction, the latter utilising maxillomandibular fixation. Although maxillomandibular fixation is a cost-effective method, it may restrict normal dietary intake, leading to weight loss and potential malnutrition that can negatively impact recovery. **Objective:** To assess weight changes in mandibular fracture patients following maxillomandibular fixation. **Methods:** A comparative cross-sectional study was conducted at the Pakistan Institute of Medical Sciences from November 2023 to April 2024, enrolling 75 adult patients (ages 18-50) undergoing maxillomandibular fixation for mandibular fractures. Weight measurements were recorded preoperatively and at one and four weeks postoperatively. Statistical analysis was performed using SPSS Version 27.0. **Results:** The mean age of participants was 26.4 years, with 92% being male. The average preoperative weight was 63.08 kg, decreasing significantly to 58.57 kg after one week and 57.57 kg after four weeks ($p<0.001$). This weight loss was attributed to dietary restrictions and discomfort from jaw immobilisation. **Conclusions:** It was concluded that this study reveals significant weight loss post-maxillomandibular fixation, indicating a need for targeted nutritional support during recovery. These findings emphasize the importance of developing effective intraoperative and postoperative care protocols to meet nutritional needs, potentially enhancing recovery outcomes and quality of life for patients. Future research should explore the long-term effects of weight changes and interventions to mitigate weight loss during recovery.

INTRODUCTION

Maxillofacial injuries are commonly caused by car accidents, falls, physical assaults, and sports activities [1]. Mandible fractures are prevalent in maxillofacial injuries and are typically treated in two ways. The first possibility is open reduction, in which intraoral or extraoral incisions are used, allowing visualisation, reduction, and fixation of the fractured segments with screws, plates, and wires. The other option is a closed reduction using maxillomandibular fixation (MMF) that immobilises the fractured segments by securing the upper and lower jaws adjacent to each other to promote healing [2]. This closed reduction technique limits normal food intake, particularly solid and semisolid foods, often resulting in weight loss and malnutrition, which in turn can affect recovery [3, 4]. Despite the risk of malunion, non-union, malnutrition, and periodontal inflammation, MMF is widely used. The duration of MMF varies based on the type and location of the fracture, the patient's age and health, and other factors, but generally lasts 3 to 6 weeks [5]. Many studies show a direct link between nutrition and the body's healing process, suggesting that MMF could affect recovery. MMF has the advantages of being inexpensive and non-technique

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sensitive. However, MMF is not without risk, and its effect on nutrition intake emphasizes the need for appropriate care and monitoring during treatment [6, 7]. According to a study conducted by Kayani *et al.*, they enrolled 30 patients with a mean age of 36.67 ± 9.743 years. Out of these patients, 90% were male and 10% were female. The participants had a pre-operative weight of 80.57 ± 9.995 kilograms, and by the fourth week after the surgery, their weight decreased to 76.47 ± 10.244 kilograms.The study found that patients experienced a weight loss of 6 kilograms by the end of the first week after the surgery, and this weight loss was maintained at 5 kilograms by the fourth week. The authors concluded that significant weight loss was observed among all patients in the first week following operation [8]. In a study conducted by Yazadani *et al.*, a total of sixty patients were enrolled. Their initial weights ranged from 49 to 98 kilograms, with an average weight of 69.45 ± 1.6 kilograms before undergoing inter-maxillary fixation (IMF). After 4 weeks, the mean weight showed a decrease of approximately 2.64 kilograms, reaching around 66.81 ± 1.4 kilograms (p=0.025). The study also observed the highest weight loss of 5 kilograms in one patient. The study suggests that while severe and acute malnutrition was not observed among patients, IMF did lead to mild to moderate malnutrition in some cases [9]. In the study conducted by Lone *et al.*, 300 patients were selected, out of which only 6 experienced mild malnutrition. 68.87 ± 11.250 kilograms was recorded as the average weight of participants preoperatively, which decreased to 65.25 ± 11.286 in the 5th week following surgery.The results of this study were found to be statistically significant (p<0.001)[6].

This study aims to assess the weight changes in patients with mandibular fractures following maxillomandibular fixation. Through examining the rate of weight reduction, this study provided valuable insights that could enhance patient care and deepen our comprehension of MMF's influence on general health.

METHODS

A comparative cross-sectional study was carried out in the Department of Oral and Maxillofacial Surgery at the Pakistan Institute of Medical Sciences in Islamabad between November 2023 and April 2024. Ethical Approval was given by the ethical review board of Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad (no. F. 1-1/2015/ERB/SZABMU/1065). Using the WHO sample size calculator and assuming a postoperative mean weight of 66.8 ±11.4), a 95% confidence level, and an absolute precision of 0.35 [9], the sample size was determined to be 75 participants. Using a non-probability purposive sampling technique, the study enabled researchers to choose volunteers who fudelfilled particular requirements pertinent to the study's goals. Participants were chosen according to present inclusion criteria, which included being between the ages of 18 and 50 years, irrespective of gender, presenting with a history of maxillofacial trauma with isolated mandibular fracture and receiving maxillomandibular fixation (MMF) without concurrent open reduction and internal fixation. These patients reported a history of maxillofacial trauma further classified based on etiology of trauma such as a history of falls from a minimum height of 6 to 7 feet, Road Traffic accidents, Physical Assault and sports injuries. Patients with poly-trauma, diabetes, cardiovascular or renal diseases, chronic obstructive pulmonary disease (COPD), altered consciousness from head injuries, pregnant women, and those with bi-maxillary or complex facial fractures were among the exclusion criteria created to guarantee the study's safety and applicability. Informed written consent was obtained from all participants. Demographic data were meticulously recorded, including participants' names, ages, genders, causes of trauma, and the duration of MMF before treatment. Participants were categorized into three distinct age groups to facilitate analysis of age-related effects. Group A included participants aged 18-28, Group B included those aged 29-39, and Group C included participants aged 40-50. Eligible patients underwent a standardized four-week maxilla-mandibular fixation using stainless steel wires. To address dietary constraints brought on by the surgical process, participants were given a liquid diet supplemented with nutritional supplements during this time. Weight measurements were meticulously taken at three-time points: immediately before surgery, one week postoperatively, and at the end of the four-week fixation. Upon completion of the four weeks, the MMF was removed from all participants. Data were systematically entered and analyzed using SPSS Version 27.0. Frequencies and percentages were used to represent categorical factors, such as gender and trauma cause. The averages and standard deviations of numerical variables, including age and preoperative and postoperative weights, were displayed. A paired sample t-test was used to compare preoperative and postoperative weights, and the data were further stratified by age, gender, and trauma origin to enable a more in-depth examination of the findings. Additionally, differences within particular subgroups were examined using post-stratified paired t-tests. A p-value of less than 0.05 was deemed statistically significant, indicating meaningful differences in weight changes throughout the study. This thorough methodological approach was designed to ensure the reliability and validity of the findings.

RESULTS

Results indicates a mean age of 26.40 ± 9.262, with a male predominance, making up 92% of the cohort. Most participants belonged to the younger age range, as 64% were in Group A. The demographic characteristics of the participants are summarized in Table 1.

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Table 1: Demographic Details of the Study Population

Variables	Frequency (%)
Gender	
Male	69 (92.0%)
Female	6 (8.0%)
Age of Participants	
Group A	48 (64.0%)
Group B	18 (24.0%)
Group C	9 (12.0%)
Etiology of Trauma	
RTA	59 (78.7%)
Fall	10 (13.3%)
Physical Assault	5 (6.7%)
Sport Injury	1 (1.3%)
Total	75 (100%)

The mean preoperative weight of the patients was recorded as 63.0833 ± 14.88503. Notably, the mean weights observed at subsequent intervals were 58.5707 ± 14.34538) after the first week post-surgery and 57.5687 ± 14.18959 after the fourth week, showing a gradual weight decline following the procedure. Weight measurements at various intervals are presented in Table 2.

Table 2: Descriptive Statistics of Participant Demographics and Weight Measurements

Variables	No. of Participants	Minimum	Maximum	Mean ± SD
Age of Participants	75	18	50	26.40 ± 9.262
Weight –Preoperative	75	38.70	110.00	63.0833 ± 14.88503
Weight-First Week Postoperatively	75	34.00	102.00	58.5707 ± 14.34538
Weight-Fourth Week Postoperatively	75	33.00	102.60	57.5687 ± 14.18959

The paired sample t-tests significant interaction between genders, with male showing greater weight loss across all time points compared to female. The results highlight a consistent trend of postoperative weight reduction, particularly in male participants. The weight changes of participants (preoperatively, one week postoperatively, and four weeks postoperatively) stratified by male and female are presented in Table 3.

Table 3: Postoperative Weight Changes After Stratification with Gender

Gender of the Participant		Mean ± SD	p-value
Male	Pair 1-Weight of the Participants-Weight of the Patient First Postoperatively	4.53406 ± 2.07677	0.000
	Pair 2-Weight of the Participants-Weight of the Patient's Fourth Postoperatively	5.53188 ± 3.14059	0.000
Female	Pair 1- Weight of the Participants of the Patient First Postoperatively	4.26667 ± 2.24470	0.006
	Pair 2-Weight of the Participants-Weight of the Patient's Fourth Postoperatively	5.31667 ± 3.36477	0.012

Furthermore, the study highlights the statistically significant differences in mean weight changes, with p-values of 0.000 for both the preoperative to the first week and preoperative to fourth-week comparisons and 0.002 for the first week to the fourth-week comparison. This table also explores the weight change across different age groups, with significant p-values mostly at 0.000. Notably, the first-week-to-fourth-week comparison was not statistically significant in Group A (p=0.054) and Group C (p=0.159). This analysis highlights the varied impact of age on postoperative weight changes, as shown in Table 4.

Table 4: Postoperative Weight Changes After Stratification by Age Group

Variables	Mean ± SD	p-value
Preoperative Weight-Postoperative Weight After First Week	4.51267 ± 2.07583	0
Preoperative Weight-Postoperative Weight After Fourth Week	5.51467 ± 3.136	0
Postoperative Weight After First Week-Postoperative Weight After Fourth Week	1.0020 ± 2.691	0.002
Age Group A		
Preoperative Weight-Postoperative Weight After First Week	3.98437 ± 2.106	0
Preoperative Weight-Postoperative Weight After Fourth Week	4.71875 ± 2.964	0
Postoperative Weight After First Week-Postoperative Weight After Fourth Week	0.73438 ± 2.575	0.054
Age Group B		
Preoperative Weight-Postoperative Weight After First Week	5.68889 ± 1.819	0
Preoperative Weight-Postoperative Weight after Fourth Week	7.18333 ± 3.264	0
Postoperative Weight After First Wee-Postoperative Weight After Fourth Week	1.49444 ± 2.997	0.049
Age Group C		
Preoperative Weight-Postoperative Weight After First Week	4.97778 ± 1.316	0
Preoperative Weight-Postoperative Weight After Fourth Week	6.42222 ± 2.387	0
Postoperative Weight After First Week-Postoperative Weight After Fourth Week	1.44444 ± 2.787	0.159

Analysis shows the mean weight changes of patients after four weeks postoperatively, stratified by the etiology of trauma, with a total of 75 patients. The Chi-Square test results indicate no significant differences in weight changes among the different trauma groups, with a p-value of 0.292, as shown in Table 5.

Table 5: Fourth Week Postoperative Weight Changes After Stratification by Etiology of Trauma

Etiology of Trauma	No of Patients	Maximum	p-value
RTA (59)	59	57.86 ± 13.69	0.292
Fall (10)	10	51.60 ± 11.89	

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Assault	5	66.44 ± 22.32	
Sport Injury	1	56.00 ± 1.0	
Total	75	57.5687 ± 14.19	

DISCUSSION

The classic technique of immobilizing the jaws for the treatment of maxillofacial fractures is called maxillomandibular fixation (MMF). For minimally displaced fractures, MMF is an alternate option that may be able to avoid open surgery and its associated problems, even though open reduction and internal fixation (ORIF) offer an early recovery. In terms of lower treatment expenses, shorter hospital stays, and avoiding the postoperative complications of open surgery, it produces better results.[3] Important insights into demographic traits, weight variance, and the overall impact of MMF on recovery were uncovered by analyzing the data gathered from 75 participants. In our study, most patients undergoing maxillomandibular fixation (MMF) were young adults, with a mean age of 25.4 years, consistent with the findings of Derebaşınlıoğlu *et al.*, who reported that road traffic accidents, interpersonal violence, and sports-related injuries are common causes of maxillofacial trauma in this age group [10]. Additionally, 92% of the patients in our study were male, confirming the male predominance observed in the literature by Khan *et al.*, Kanala *et al.*, and Bicsák *et al.*, which highlights a higher incidence of facial fractures in men compared to women [11-13]. This is further stratified with gender through a paired sample t-test, which demonstrated a statistically significant relationship between gender, and weight changes. Due to the higher percentage of male patients with a small number of female patients, these statistics cannot be applied to the general population.It also emphasizes the importance of implementing targeted prevention strategies for high-risk groups, particularly young male [14]. The mean weight of the participants decreased from preoperative measurements (63.0833 kg) to the first week postoperatively (58.5707 kg), and this trend continued to the fourth week (57.5687 kg). This substantial weight loss can be caused by several factors related to MMF: likely restrictive diet intake, pain, and difficulty eating due to jaw immobilization.The p-values for the comparison of preoperative weight to the weight taken at the first and fourth weeks postoperatively were statistically significant at 0.000 and for the first week to the fourth week at 0.002. This suggests that weight loss is a direct result of this intervention rather than an incidental finding. Similar results were reported by Homaid *et al.*, Inaba *et al.*, and Pillai *et al.*, [15-17]. Moreover, it is important to study the relationship between age and weight variation, because younger participants may respond to the surgery differently metabolically than the older population. Weight loss not only affects physical health but also has potential implications for psychological well-being and recovery. The fact that weight loss may result in diminished strength, decreased energy, and a longer recovery period highlights the significance of controlling nutrition following surgery [18, 19]. In our study, the analysis of weight changes following maxillomandibular fixation (MMF) revealed non-significant postoperative weight loss, with a mean weight of 57.86 kg for patients with road traffic accidents and 51.60 kg for those who experienced falls, yielding a p-value of 0.292. This finding is consistent with recent research by Zaidi *et al.*, which reported an average weight loss of 2.57 kg after MMF with a significant p-value, emphasizing the impact of surgical intervention on patient weight and the necessity for nutritional management during recovery to mitigate potential complications [20]. The results of this study demonstrate the need to provide patients undergoing MMF with thorough postoperative care that includes counselling and nutritional support [21]. Healthcare professionals must put systems in place to guarantee patients obtain enough nutrition during their recuperation, given the possibility of weight loss. High-calorie, easily digested foods and additional nutritional drinks that aid in weight maintenance may fall under this category [22, 23]. By showing a significant decrease in mean weight following maxillomandibular stabilization in individuals with maxillofacial fractures, this study accomplishes its objective.The results emphasize the need for more studies to develop efficient postoperative care guidelines that address these patients' dietary needs, thereby enhancing their quality of life and recovery results. Future research should examine potential strategies to lessen the impact of weight loss during recovery after MMF, as well as the long-term impacts of weight alterations.

CONCLUSIONS

It was concluded that the significant weight loss that patients with maxillofacial fractures have following maxillomandibular fixation (MMF) is highlighted in this study,underscoring the critical need for targeted nutritional support after surgery.The findings highlight how crucial it is that medical professionals put plans in place to satisfy these patients' nutritional needs to aid in their rehabilitation and enhance their quality of life.The long-term impacts of weight fluctuations should be investigated further, as should possible countermeasures. Putting a high priority on comprehensive postoperative care will eventually improve results for patients having MMF

Authors Contribution

Conceptualization: RA
Methodology: RA, BP, HUM MKS
Formal analysis: MUF
Writing review and editing: RAB

All authors have read and agreed to the published version of the manuscript

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Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] Hino S, Yamada M, Iijima Y, Ohmuro M, Araki R, Kaneko T *et al.* Change of Body Composition, Physical Strength, and Nutritional Status of Patients with Mandibular Fractures. Journal of Cranio-Maxillofacial Surgery. 2021 Apr; 49(4): 292-7. doi: 10.1016/j.jcms.2021.01.023.

[2] Grillo R, da Silva YS, Tavares MG, Borba AM, Samieirad S, da Graça Naclério-Homem M. Which Sports Have a Higher Risk of Maxillofacial Injuries? Journal of Stomatology, Oral and Maxillofacial Surgery. 2023 Feb; 124(1): 101341. doi: 10.1016/j.jormas.2022.11.017

[3] Popat SP, Rattan V, Rai S, Jolly SS, Malhotra S. Nutritional Intervention During Maxillomandibular Fixation of Jaw Fractures Prevents Weight Loss and Improves Quality of Life. British Journal of Oral and Maxillofacial Surgery.2021 May; 59(4): 478-84. doi: 10.1016/j.bjoms.2020.10.009.

[4] Lone PA, Khaliq MI, Sharma M, Malik OA, Lone BA. Weight Changes (In Kg) In Mandible Fracture Patients After IMF: A Prospective Study. The Traumaxilla.2019 Apr; 1(1): 35-7. doi: 10.1177/2632327319882801.

[5] Balihallimath L, Jain R, Mehrotra U, Rangnekar N. To Compare the Efficiency of Maxillomandibular Fixation Screws Over Erich Arch Bar in Achieving Inter-Maxillary Fixation in Maxillofacial Trauma: A Clinical Study. Journal of the International Clinical Dental Research Organization.2018 Jan; 10(1): 27-31. doi: 10.4103/jicdro.jicdro_23_17.

[6] Ludwig DC, Huang K, Lynch S, Koceja L, Tressel W, Dillon JK. What is the Role of Nutrition Counseling in the Management of Isolated Mandible Fractures? Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology.2019Nov;128(5):464-71.doi:10.1016/j.oooo.2018.12.005.

[7] Kao R, Rabbani CC, Patel JM, Parkhurst SM, Mantravadi AV, Ting JY *et al.* Management of Mandible Fracture in 150 Children Across 7 Years in A US Tertiary Care Hospital. Journal of American Medical Association Facial Plastic Surgery.2019 Sep; 21(5): 414-8. doi: 10.1001/jamafacial.2019.0312.

[8] Ghafoor Kayani SA, Ahmed W, Farooq M, Ur Rehman AT, Nafees Q, Mushtaq Baig AM. Weight Loss Due to Maxillomandibular Fixation in Mandibular Fractures. Pakistan Oral and Dental Journal.2015 Sep; 35(3).

[9] Yazdani J, Hajizadeh S, Ghavimi MA, Gargari BP, Nourizadeh A, Kananizadeh Y. Evaluation of Changes in Anthropometric Indexes Due to Inter-Maxillary Fixation Following Facial Fractures. Journal of Dental Research, Dental Clinics, Dental Prospects.2016; 10(4): 247. doi: 10.15171/joddd.2016.039.

[10] Derebaşınlıoğlu H and Cankorkmaz L. Age Distribution of Mandibular Fractures and Concomitant Injuries. European Journal of Plastic Surgery.2022Oct;45(5): 747-53. doi: 10.1007/s00238-022-01967-w.

[11] Khan TU, Rahat S, Khan ZA, Shahid L, Banouri SS, Muhammad N. Etiology and Pattern of Maxillofacial Trauma.Plos One.2022Sep;17(9):e0275515.doi:10.1371/journal.pone.0275515.

[12] Kanala S, Gudipalli S, Perumalla P, Jagalanki K, Polamarasetty PV, Guntaka S *et al.* Aetiology, Prevalence, Fracture Site and Management of Maxillofacial Trauma. The Annals of the Royal College of Surgeons of England.2021 Jan; 103(1): 18-22. doi: 10.1308/rcsann.2020.0171.

[13] Bicsák Á, Abel D, Berbuesse A, Hassfeld S, Bonitz L. Evaluation of Mandibular Fractures in A German Nationwide Trauma Center Between 2015 and 2017. Journal of Maxillofacial and Oral Surgery. 2021 Jan: 1-7. doi: 10.1007/s12663-021-01513-4.

[14] Wusiman P, Maimaitituerxun B, Saimaiti A, Moming A. Epidemiology and Pattern of Oral and Maxillofacial Trauma. Journal of Craniofacial Surgery.2020 Jul; 31(5): e517-20. doi: 10.1097/SCS.0000000000006719.

[15] Homaid WA, Nasher AT, Al-Shamahy HA, Ahmed ST, Mabkhout AN, Khalid BS *et al.* Effect of Inter-Maxillary Fixation On Biochemical and Blood Markers in A Sample of Yemeni Adults.Universal Journal of Pharmaceutical Research.2024Sep.doi:10.22270/ujpr.v9i4.1147.

[16] Inaba Y, Hasebe D, Hashizume K, Suda D, Saito N, Saito D *et al.* Changes in Nutritional Status of Patients with Jaw Deformities Due to Ortho-Gnathic Surgery. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology.2023 Mar; 135(3): 347-54. doi: 10.1016 /j.ooo.2022.07.007.

[17] Pillai MP, Lahoti K, Tenglikar PD, Sharma A, Singh SP. A Comparative Study of Psychological Analysis During Inter-Maxillary Fixation Between Second and Third Decade. World Journal of Advanced Research and Reviews.2022; 13(1): 689-92. doi: 10.30574/ wjarr. 2022.13.1.0058.

[18] Bhat MY, Bashir S, Ahmed I. Effect of Inter-Maxillary Fixation On Para-Clinical Indexes. International Journal of Applied Dental Sciences.2022; 8(2): 381-. doi: 10.22271/oral.2022.v8.i2f.1532.

[19] Iftikhar B, Zulfiqar G, Azam M, Ahmad M. Effect of Treating Mid-Face Fracture On Nutritional Status. The Professional Medical Journal.2024 Mar; 31(03): 473-9. doi: 10.29309/TPMJ/2024.31.03.7928.

DOI: https://doi.org/10.54393/pjhs.v6i2.2680

[20]Zaidi SW, Ahmed S, Kashif M, Rehman A, Azeem S, Qamar A. Determination of Weight Loss in Mandibular Fracture Patients After Maxillomandibular Fixation. Journal of Xi'an Shiyou University.2022 Dec;18(12):620-633.

[21] Ooi K, Inoue N, Matsushita K, Yamaguchi H, Mikoya T, Kawashiri S *et al.* Body Weight Loss After Ortho-Gnathic Surgery: Comparison Between Postoperative Inter-Maxillary Fixation with Metal Wire and Elastic Traction, Factors Related to Body Weight Loss. Journal of Maxillofacial and Oral Surgery.2021 Mar; 20: 95-9. doi: 10.1007/s12663-019-01318-6.

[22]Çelik ZM, Bayram F, Aktaç Ş, Berkel G, Güneş FE. Evaluation of Pre-and Postoperative Nutrition and Oral Health-Related Quality of Life in Ortho-Gnathic Surgery Patients. Nutrition.2024 Jul; 123: 112418. doi: 10. 1016/j.nut.2024.112418.

[23]Benato L, Miotto AV, Molinari RL, Olsson B, Carlos LD, Thieme RD *et al.* Body Mass Index and Weight Loss in Patients Submitted to Ortho-Gnathic Surgery: A Prospective Study. Dental Press Journal of Orthodontics.2023Nov;28(05):e2323107.doi:10.1590/2177-6709.28.5.e2323107.oar.