Journal Pre-proof

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PII: S0899-9007(24)00068-6
DOI: https://doi.org/10.1016/j.nut.2024.112418
Reference: NUT 112418

To appear in: *Nutrition*

Received date: 6 December 2023
Revised date: 5 February 2024
Accepted date: 3 March 2024

Please cite this article as: Zehra Margot ÇELİK PhD , Ferit BAYRAM PhD, DDS , Şule AKTAÇ PhD , Gülcan BERKEL PhD, MD , Fatma Esra GÜNEŞ PhD , Evaluation of Pre- and Post-operative Nutrition and Oral Health-Related Quality of Life in Orthognathic Surgery Patients, *Nutrition* (2024), doi: https://doi.org/10.1016/j.nut.2024.112418

Highlights

- Decline in food intake and difficulties meeting energy and nutrients after surgery.
- Decline in chewing ability and difficulties chewing hard foods at post-op 3rd month.
- Oral health-related quality of life decreased and then increased over time.
- Nutritional care standards are needed for orthognathic surgery patients.

Evaluation of Pre- and Post-operative Nutrition and Oral Health-Related Quality of Life in Orthognathic Surgery Patients

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Author Contributions: ZMÇ, FB, ŞA, GB and FEG equally contributed to the conception and design of the research; ZMÇ, FB and ŞA contributed to the acquisition and analysis of the data; ZMÇ, FB and ŞA contributed to the interpretation of the data; ZMÇ and FB, drafted the manuscript. All authors critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

Disclosures

Financial: None declared.

Conflicts of interest: None declared.

Acknowledgements: -

Abstract

Objective: Orthognathic surgery is a complex orofacial surgery that can significantly impact occlusal function and effect nutritional and quality of life parameters. This study aimed to evaluate alterations in dietary intake, chewing function, physical activity, and oral health-related quality of life of patients undergoing orthognathic surgery.

Research Methods & Procedures: In this prospective longitudinal study, the assessments were conducted at: preoperatively (T0) and postoperative 1st week (T1), 2nd week (T2), 1st month (T3), and 3rd month (T4) between May 2021 and March 2023. Sociodemographic questionnaire, 24-hour dietary recall record, chewing ability form, International Physical Activity Questionnaire, and Oral Health Impact Profile-14 (OHIP-14) was applied at face-to-face interviews.

Results: Seventy eligible orthognathic surgery patients were evaluated, and 37 patients (52.8%) completed this study. Energy and fat intake significantly decreased from T0 to T1 ($p<0.001$) and returned to basis by T4 ($p=0.015$). Fiber intake was found to be lowest at T1 and T2 compared with other time points ($p<0.001$). Chewing ability showed a deterioration and then improvement; however, patients still had difficulties chewing hard foods at T4. The OHIP-14 increased at T2 and T3 from T0 ($p<0.001$ and $p=0.021$, respectively) and showed a significant improvement at T4 ($p<0.05$).

Conclusion: The findings indicate a temporary decline in nutritional intake and chewing ability

with subsequent recovery by the third month post-surgery. These changes, along with the trends in oral health-related quality of life, underscore the need for tailored nutritional and functional rehabilitation programs following orthognathic surgery.

Keywords: nutrition, quality of life, orthognathic surgery, dentofacial deformities, maxillofacial abnormalities

INTRODUCTION

Nutrition and oral health are closely interrelated; adequate nutrition requires not only healthy teeth but also proper oral function. Impaired oral health, which can interfere with daily food intake, can ultimately lead to impaired nutritional status.[1] In additions, skeletal occlusal disorders, known as malocclusion, contribute to poor oral health by impairing masticatory function, thus affecting overall food intake.[2]

Orthognathic surgery is a complex orofacial surgical operation widely used as a standard treatment to correct malocclusions of the jaws and leads to extensive changes in the soft tissues and skeletal structure of the maxillofacial region.[3-5] Correction of the maxillomandibular relationship has significant effects on occlusal function, articulation, respiration, and aesthetics postoperatively.[3] A characteristic feature of orthognathic surgery is the temporary restriction of jaw movements through intermaxillary fixation during the postoperative recovery period, lasting approximately 3-4 weeks.[6] This restriction requires patients to be fed pureed or liquid diets, leading to unique nutritional challenges.[7] Given the special nutritional needs of surgical patients, it is of critical interest to investigate nutrition, chewing ability and physical mobility and their impact on quality of life during this period.

Orthognathic surgery techniques and related complications have been extensively studied in the oral and maxillofacial surgery literature.[8-10] However, there is a lack of research on the nutritional assessment of orthognathic surgery patients and its impact on oral health-related quality of life.

To address this gap, this study was designed to assess changes in macro- and micronutrient intake, as well as changes in chewing ability and physical activity levels in patients with dentofacial deformities undergoing orthognathic surgery in the pre- and postoperative periods, as well as to determine the impact on oral health-related quality of life. The findings are expected to provide insights that can guide future nutritional interventions for individuals undergoing orthognathic surgery.

MATERIALS AND METHODS

Study design and participants

This prospective longitudinal study was conducted at XXX University, between May 2021 and March 2023. The study was registered in ClinicalTrials.gov (registration number: NCT05591963), conducted following the Declaration of Helsinki and approved by the XXX University XXX Ethics Committee (Approval number: 29.04.2021/48).

The study population was the patients who applied to XXX University Faculty of Dentistry, Department of Oral, Dental and Maxillofacial Surgery Clinic for surgery within 6 months (N=48). The sample size was calculated using the EpiInfo program. In this calculation, when the event frequency was taken as 50%, the error level as 5% and the pattern effect as 1, the sample size was determined as 37 with 80% confidence interval. All patients who were scheduled for orthognathic surgery and met the eligibility criteria in the time of the study were invited to participate. Written and verbal informed consent was obtained from each patient who accepted participation. Inclusion criteria were defined as patients between the ages of 18-45 years who were willing to participate

in the study and who would undergo orthognathic surgery due to malocclusion. Patients who underwent only genioplasty or isolated mandibular or maxillary surgery, had acute facial trauma, previous facial surgeries, diseases that could cause systemic neuropathy such as diabetes, hypertension, renal disease, history of eating disorders or history of malignancy, radiotherapy or chemotherapy, and were pregnant or lactating were excluded from the study.

Data collection and evaluation

Sociodemographic questionnaire

Patients were enrolled in the study preoperatively and were followed up for three months post surgery. A questionnaire assessing sociodemographic characteristics and general health status was administered to all participants. Data collection was conducted at five time points: preoperative (T0), 1st week postoperative (T1), 2nd week postoperative (T2), 1st month postoperative (T3), and 3rd month postoperative (T4).

Evaluation of dietary intake

To evaluate dietary intake, a 24-hour dietary recall method was used by an expert dietitian at T0, T1, T2, T3 and T4. The amounts of energy, macro and micro-nutrients included in the meals was calculated by using the "Standard Recipes" book, and the portion sizes were determined by using the "Food Photo Catalog" book. To calculate daily energy, macro- and micronutrient intakes, the "Computer Assisted Nutrition Program, Nutrition Information Systems Package Program (BeBiS)" was used.

The national nutrition guidelines were used to determine the adequacy of macronutrient and micronutrient intake levels.[11] For carbohydrate, protein and dietary fat, Acceptable Macronutrient Distribution Ranges (AMDR) were used. Percentages of meeting estimated average requirements (EAR) for vitamin D, vitamin A, vitamin B1, vitamin B2, vitamin B6, folate, vitamin C, calcium,

iron and zinc and adequate intake (AI) for dietary fiber, dietary cholesterol, vitamin K, vitamin E, niacin, vitamin B12, sodium, potassium, magnesium, and phosphorus were calculated.

Evaluation of chewing ability

A questionnaire consisting of closed-ended questions was used to determine the chewing difficulties of individuals at T0, T3 and T4. The ability to chew the listed foods was questioned as "easy to chew", "I have some difficulty chewing", "I have a lot of difficulty/I can't chew at all".[12] Individuals were evaluated as having "difficulty in chewing" if they answered "I have some or a lot of difficulty" for at least two hard foods or "I have some or a lot of difficulty" for at least four soft foods.[13] These listed foods were bread, pasta, rice, feta cheese, meatball, boiled carrot and boiled vegetables as soft foods and whole piece of meat, fried chicken, peeled apple, raw carrot, almond/hazelnut and piece of chocolate as hard foods.[12]

Evaluation of physical activity level

The preoperative and postoperative physical activity levels of the patients included in the study were evaluated with the short version of the International Physical Activity Questionnaire (IPAQ), which was administered at T0, T2, T3 and T4. The International Physical Activity Questionnaire Short Version (7 questions) is used to assess physical activity in 4 domains over the preceding seven days. While evaluating the activities, it is accepted that each activity had been carried out for at least 10 minutes at a time. The "MET-min/week" score is obtained by multiplying the metabolic equivalent (MET) value by day and minute for each activity level.[14] According to the general scores, physical activity level is classified as inactive if it is between 0-600 MET, as mildly active if it is between 600-3000 MET and as active if it is above 3000 MET.[15]

Evaluation of quality of life

The Oral Health Impact Profile-14 was used to determine oral health related quality of life of the

patients at T0, T2, T3 and T4. The Oral Health Impact Profile-49 (OHIP-49), described by Slade and Spencer, is a self-reported scale designed to assess quality of life related to people's perceptions of the impact of oral diseases on their well-being.[16] However, due to the large number of items in the OHIP-49, a shortened version (OHIP-14) consisting of only 14 items was developed while retaining the original conceptual dimensions.[17] In 2014, a Turkish validity and reliability study of the OHIP-14 was conducted by Başol et al.[18] The Oral Health Impact Profile-14 consists of 14 questions and 5 answers that can be scored between 0-4 for each question. These answers were determined according to a Likert scale as "0=never, 1=rarely, 2=sometimes, 3=often and 4=always". In OHIP-14, the evaluation was made based on subscales separately in categories under the main headings: functional limitation (questions 1 and 2), physical pain (questions 3 and 4), psychological discomfort (questions 5 and 6), physical disability (questions 7 and 8), psychological disability (questions 9 and 10), social disability (questions 11 and 12) and handicap (questions 13 and 14). The sum of all these category scores is given. The total score of the OHIP-14 is between 0 and 56. As the total score increases, it is concluded that the severity of the problem increases and the oral health-related quality of life decreases.[17,19]

Statistical analysis

The data obtained were evaluated statistically with the SPSS 28.0 package program. The compliance of the variables with a normal distribution was checked with the one-sample Kolmogorov–Smirnov test. Categorical variables were described as frequency distributions, and continuous variables were described as the mean ± SD. When analyzing the change in data over time, ANOVA was applied for parametric data, and the Friedman test was applied for nonparametric data. All analyses were calculated at a 95% confidence interval, and statistical significance was accepted as $p<0.05$.

RESULTS

Sociodemographic questionnaire

Seventy patients who were eligible to participate in the study were evaluated. However, the study was completed with 37 patients when patients were excluded from the study for a variety of reasons (Figure 1). The baseline characteristics of the study group are presented in Table 1. Of the patients who completed the study, 59.5% (n=22) were female, the mean age of the study group was 25.24 ± 6.4 years, and the mean preoperative BMI was 23.21 ± 4.2 kg/m2.

Dietary intake

It was found that the patients 81.1% (n=30) skipped at least one meal a day, and this was mostly lunch, a percentage of 51.4% (n=19) (Table 1). When the reasons for skipping meals were questioned, it was determined that the most frequently given answer was lack of time, at 37.8% (n=14) (not shown in table).

Table 2 shows the percentage at which the recommended daily energy needs are fulfilled, with the mean percentages of carbohydrate, protein and fat in the diet, and EARs and AIs of micronutrients according to the national dietary guidelines. All values are given across five time points (T0 to T4). Energy (kcal/day) was found to be lowest at T1; this was significantly different from all other timelines. At T4, energy was also statistically significantly higher than that at T2 ($p < 0.001$). Carbohydrate intake was lowest at T4, with a statistically significant difference from T1 ($p = 0.010$). Although protein intake did not show a statistically significant difference over the timeline, dietary fat intake was significantly higher at T4 than at T1 ($p = 0.015$). Dietary fiber intake was lower at T1 and T2 than at other T times ($p < 0.001$). Dietary cholesterol intake was similar at T0 and T3, lowest at T1 and highest at T4; the difference was statistically significant ($p < 0.001$). There were statistically significant differences in the intakes of vitamin B2, vitamin B12, vitamin

E, vitamin K, folate and niacin and all minerals analyzed at T time points ($p < 0.05$).

Chewing ability

Figure 2 shows the patients' ability to chew some soft and hard foods at T0, T3 and T4 based on their self-reports. In the preoperative period, most patients (86.5%) reported no difficulty chewing soft foods, indicating a generally healthy oral function in the sample at baseline. Only a small fraction of patients experienced some challenges with chewing, with 3 patients categorizing it as "a bit difficult" and 2 as "very difficult," suggesting a minor prevalence of oral health issues in this initial period. Following the operation, T3 marked a substantial shift in patients' chewing abilities. A clear drop was noted in the number of patients who found chewing to be "easy," decreasing to 11. Conversely, the groups finding it "slightly difficult" and "very difficult" increased (n=8, n=18; respectively). A large majority, similar to T0, found chewing to be "easy" (n=30) by T4. Those experiencing "slightly difficult" and "very difficult" chewing decreased (n=6; n=1; respectively). In the evaluation of the ability to chew hard foods, there was a significant shift from T0 to T1, with gradual recovery by T4. At T0, the patient reports were somewhat evenly distributed among the categories: 32.4% (n=12) "easy to chew", 32.4% (n=12) "slightly difficult", and 35.2% (n=13) "very difficult". At T3, the number of patients who found it "easy to chew" hard foods dramatically decreased to 2.7% (n=1), while those who found it "a bit difficult" also decreased to 8.1% (n=3), and the majority 89.2% (n=33) found it "very difficult". By T4, there was a slight improvement in the chewing ability of the patients. The rate of those who found it "easy to chew " hard foods increased to 13.6% (n=5), those who found it "a bit difficult" increased to 40.5% (n=15), and those who found it "very difficult" decreased to 45.9 (n=17).

Physical Activity

The mean IPAQ score showed a significant decrease from a T0 score of 636.84 ± 660.39 to 397.54

± 278.14 at T2. However, by T4, the mean IPAQ score had rebounded to 1152.99 ± 1237.5. The Friedman test confirmed a significant difference between these T times ($p = 0.014$), indicating significant changes in physical activity levels as measured by the IPAQ over the three time points (not shown in table).

The Oral Health Impact Profile

Changes in OHIP-14 subcategories and the total score from T0 to T4 are presented in Table 3. For functional limitation, there was a significant increase from T0 to T2 ($p < 0.001$). At T4, the mean value returns close to the baseline and is statistically significantly lower than T2 and T3 ($p < 0.001$ and $p < 0.035$, respectively). Physical pain was also significantly higher in T2 and T3 than in T0 ($p < 0.001$ and $p = 0.017$, respectively). This subcategory shows a decreasing trend over time, and it is statistically significantly lower at T4 from T2 and T3 ($p < 0.001$ and $p = 0.012$, respectively). Physical disability peaks at T2, and the increase is statistically significant compared with T0 ($p < 0.001$); there is a subsequent decrease from T2 to near-baseline levels by T4 ($p = 0.004$). The social disability subcategory is significantly higher at T2 and T3 than at T0 ($p < 0.001$), and at T4, it is lower than at T2 ($p < 0.001$). The psychological discomfort, psychological disability and handicap subcategories showed a slight increase in the postoperative period but remained relatively stable over the observed period; the changes were not statistically significant ($p = 0.705$, $p = 0.254$ and $p = 0.096$, respectively). There was a significant decrease in the total OHIP-14 score at T2 and T3 compared to T0 ($p < 0.001$ and $p = 0.021$, respectively); there was a decrease in the following weeks, showing a significant improvement at T4 from T2 and T3 ($p < 0.001$ and $p = 0.032$, respectively).

DISCUSSION

This study investigated the effect of orthognathic surgery on dietary intake, chewing ability, physical activity, and oral health-related quality of life in individuals with dentofacial anomalies. The postoperative nutritional changes in orthognathic surgery patients and how long they affect patients' quality of life have rarely been discussed.[20,21] Most previous studies have mainly focused on the relationship between preoperative nutritional status and postoperative complications.[22-24] Our findings show that patients' dietary and physical activity levels decreased, and oral health-related quality of life was impaired after surgery. Although dietary intake and quality of life generally improved within three months, chewing difficulties persisted.

Whereas the patient's nutritional requirements are increased due to the stress and catabolic process caused by the surgery, meanwhile nutrient intake decreases as a result of maxillomandibular fixation after surgery.[25] Therefore, adequate protein and energy intake is critical in the postoperative period. In a review, it has been stated that in general reasonable goals for energy and protein intake for orthognathic surgery patients are 2500 - 3000 kcal/day and 1 - 1.5 g protein/kg body weight/day.[26] In our group of patients, energy intake, initially meeting preoperative needs, rapidly decreased postoperatively, followed by a gradual increase over time. In our study, it was found that patients at these stages showed significant decreases in energy intake.

Carbohydrate intake was lowest at the 3rd month, and it was below the recommended range of 45-60% for this age group population. Protein intake did not decrease below the recommended level, but the additional protein that is needed postoperatively was not attained. Protein was calculated based on the needs of healthy adults (0.66 g/kg body weight/day).[11] However, dietary fat intakes were above the recommended 20-35% at all T times and were significantly higher at the 3rd month. Dietary fiber intake was found to be below the national nutrition guideline recommendations, even at preoperative and decreased over time. Cholesterol, vitamin B_{12}, vitamin K, folate and zinc were

above the recommendations before the surgery and below the recommendations at the 1st week after surgery. As mentioned in the literature, after orthognathic surgery, patients are switched to a liquid diet and then to a pureed diet.[23] This change in nutrients may be due to patients frequently consumed high carbohydrate content such as fruit juices, soups, dairy products, etc. in postoperative liquid-puree period, while they consumed more animal products with high fat content as chewing increased.

Previous studies report that orthognathic surgery may enhance chewing performance, with a more significant effect observed in patients with poor preoperative chewing performance and a less pronounced impact in those with better preoperative chewing performance.[27,28] The results of a recent meta-analysis also demonstrated patients' chewing performance decreased in the short term (up to 4-6 weeks) after orthognathic surgery and then gradually improved, but not to the level of healthy controls.[29] Similar to the findings in previous studies, it was found that following the surgery, at the 1st month a substantial shift in patients' chewing abilities in our study. This trend suggests an effective recovery process, as the patients gradually regained their oral functionality, returning almost to their initial preoperative status. However, compared to the preoperative period, a higher number of patients still found it challenging to chew hard foods, suggesting that the recovery in this aspect of oral function may take longer than with soft foods.

After orthognathic surgery, patients' physical activities are temporarily restricted according to the surgeons' recommendations. Therefore, the results of our study also show that physical activity levels decreased postoperatively but returned to preoperative levels at the 3rd month.

OHIP-14 has been used in many studies to assess the quality of life of orthognathic surgery patients and these studies have shown that although quality of life decreased during the postoperative recovery period, it increased over time.[30-33] In a meta-analysis published in 2021, it was found that

orthognathic surgery had a significant positive effect on patients' quality of life when evaluated with OHIP-14.[34] In our study, the OHIP-14 outcomes reveal a postoperative peak in functional limitation, physical pain, and disability, which declines significantly to baseline levels by the third postoperative month. Psychological impacts show minimal fluctuation, remaining statistically stable. The total OHIP-14 score indicates that there is a decrease in oral health-related quality of life during the recovery process after orthognathic surgery, and a significant improvement in the following period.

The strengths of this study are that, to our knowledge, this is the first study to evaluate in detail the nutrient intake of orthognathic surgery patients' multiple times. The study was conducted by a multidisciplinary team, and patients' masticatory abilities and oral-related quality of life were also evaluated. The limitations of the study are that it was conducted in a single center, with a relatively small group, and food consumption records were taken based on patients' statement.

CONCLUSION

The study reveals that, patients undergoing orthognathic surgery experience reduced energy and nutrient intake, along with a decline in chewing ability, physical activity, and oral health-related quality of life in the weeks post-surgery. The patient's inadequate intake of energy and nutrients starting from the perioperative period and continuing in the postoperative period may negatively affect the recovery process and rate. For this reason, it is recommended to involve dietitians in the medical team from the preoperative phase, extending through recovery. With further multi-center, multi-national studies nutrition care process standards should be established and standardized.

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FIGURES AND TABLES

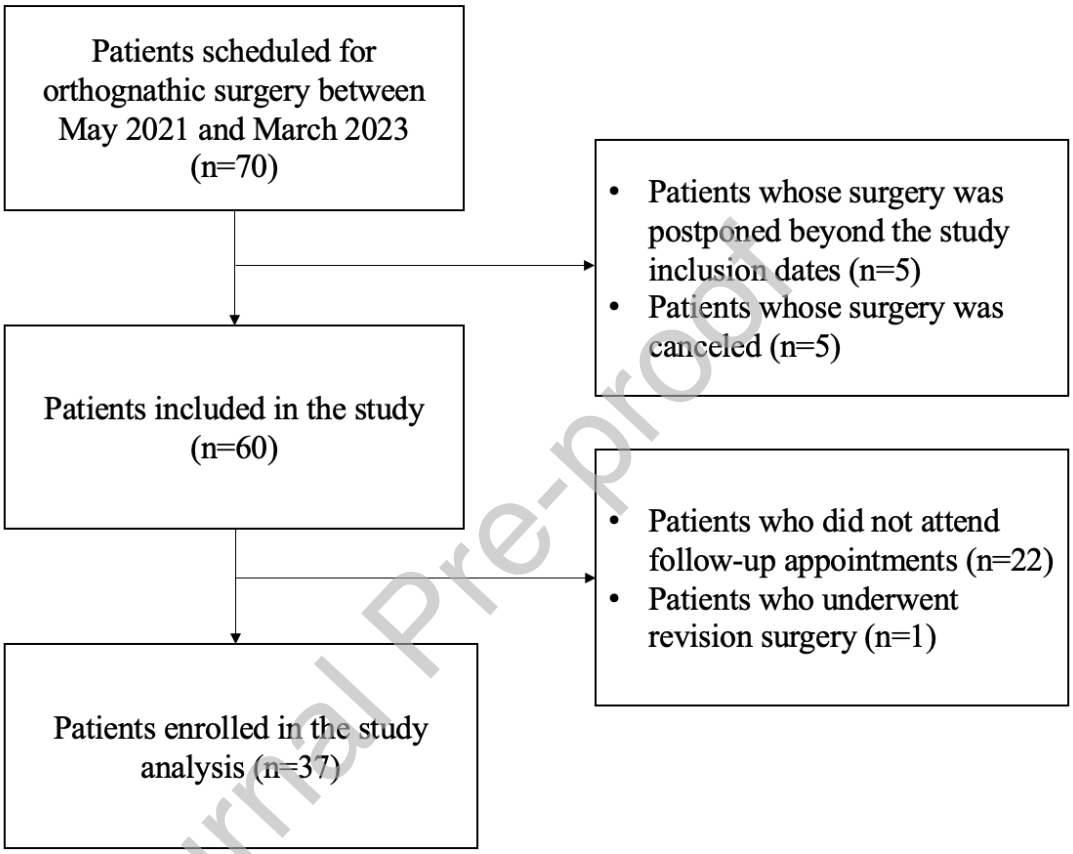


FIGURE 1 Study enrollment flowchart.

Table 1. Study group baseline characteristics

Characteristics	Female (n=22)	Male (n=15)	Total (n=37)
Age, mean (SD), years	26.41 (7.03)	23.53 (5.08)	25.24 (6.4)
BMI, mean (SD), kg/m^2	23.18 (4.93)	23.27 (2.96)	23.21 (4.2)
Education level, n (%)			
High school	2 (9.1)	1 (6.7)	3 (8.0)
Bachelor's or equivalent level	7 (31.8)	8 (53.3)	15 (40.6)

Master's or Doctoral	13 (59.1)	6 (40.0)	19 (51.4)
Employment status, n (%)			
Employed	6 (27.3)	6 (40.0)	12 (32.4)
Unemployed	16 (72.7)	9 (60.0)	25 (67.6)
Marital status, n (%)			
Married	5 (22.7)	2 (13.3)	7 (18.9)
Single	17 (77.3)	13 (86.7)	30 (81.1)
Tobacco use, n (%)			
Yes	3 (13.6)	5 (33.3)	8 (21.6)
No	19 (86.4)	10 (66.7)	29 (78.4)
Alcohol use, n (%)			
Yes	1 (4.5)	2 (13.3)	3 (8.1)
No	21 (95.5)	13 (86.7)	34 (91.)
Chronic disease status, n (%)			
Present	3 (13.6)	2 (13.3)	5 (13.5)
Not present	19 (86.4)	13 (86.7)	32 (86.5)
Physical activity level, n (%)			
Inactive	17 (77.3)	8 (53.3)	25 (67.6)
Minimal active	5 (22.7)	7 (46.7)	12 (32.4)
Active	0 (0.0)	0 (0.0)	0 (0.0)
Chewing ability, n (%)			
Chewing difficulties	17 (77.3)	10 (66.7)	27 (73.0)
No chewing difficulties	5 (22.7)	5 (33.3)	10 (27.0)
OHIP-14 score, mean (SD)	16.18 (7.74)	9.66 (7.94)	13.54 (8.37)
Number of main meals (per day) mean (SD)	2.68 (0.48)	2.87 (0.35)	2.76 (0.43)
Number of snacks (per day) mean (SD	0.59 (0.67)	0.60 (0.83)	0.59 (0.72)

Abbreviations: BMI, body mass index; OHIP-14, Oral Health Impact Profile-14

Table 2: Comparison of the percentages of meeting nutrient requirements across timeline

	T0	T1	T2	T3	T4	*p* value
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	
Energy (kcal/day)	106.17 (48.52)[ac]	64.96 (28.85)[b]	89.28 (40.26)[c]	106.79 (69.35)[ac]	126.35 (72.74)[a]	<0.001‡
Macronutrient						

% Carbohydrates	45.97 (6.66)[ab]	49.00 (10.45)[a]	45.76 (9.67)[ab]	45.81 (8.52)[ab]	41.3 (10.26)[b]	0,010†
% Protein	14.78 (4.31)	15.59 (3.93)	15.75 (3.48)	14.84 (3.33)	16.22 (5.61)	0,529†
% Fat	39.30 (6.91)[ab]	35.30 (8.84)[a]	38.52 (9.65)[ab]	39.38 (7.65)[ab]	42.16 (9.53)[b]	0,015†
EAR						
Vitamin A (µg)	283.94 (640.78)	183.93 (175.98)	203.01 (131.94)	260.19 (231.16)	218.23 (160.15)	0,462‡
Vitamin B_1 (mg)	105.47 (70.91)	101.29 (71.89)	126.76 (75.00)	137.27 (106.94)	128.62 (199.94)	0,115‡
Vitamin B_2 (mg)	158.95 (97.94)[ac]	138.72 (84.61)[a]	188.67 (78.23)[b]	201.37 (115.02)[b]	195.73 (140.83)[bc]	0,001‡
Vitamin B_6 (mg)	140.00 (80.15)	126.73 (85.54)	159.46 (85.96)	169.41 (114.68)	138.08 (87.24)	0,340‡
Vitamin C (mg)	132.74 (219.75)	221.33 (825.94)	109.56 (56.92)	173.13 (260.61)	79.91 (62.97)	0,180‡
Vitamin D (µg)	21.68 (19.63)	38.28 (43.34)	42.20 (50.32)	43.63 (44.17)	29.77 (16.29)	0,173‡
Folate (µg)	144.55 (107.90)[a]	62.70 (44.34)[b]	96.74 (71.34)[c]	128.42 (140.78)[c]	129.62 (99.16)[ac]	<0.001‡
Calcium (mg)	90.38 (42.30)[a]	104.07 (85.88)[ab]	139.81 (56.99)[b]	128.8 (72.17)[ab]	94.58 (37.17)[a]	<0.001†
Iron (mg)	185.05 (95.18)[a]	145.65 (100.69)[b]	203.97 (114.87)[a]	229.14 (158.76)[a]	222.21 (194.22)[a]	0,009‡
Zinc (mg)	133.42 (76.47)[a]	95.51 (74.35)[b]	123.85 (77.48)[a]	140.02 (116.6)[a]	173.35 (155.64)[a]	0,022‡
AI						
Dietary fiber (g)	89.61 (56.62)[a]	22.42 (22.01)[b]	42.63 (44.25)[b]	65.15 (78.95)[a]	78.16 (56.25)[a]	<0.001†
Cholesterol (mg)	123.87 (92.05)[a]	17.10 (18.00)[b]	50.99 (53.78)[c]	136.19 (164.19)[a]	203.48 (134.83)[d]	<0.001‡
Vitamin E (mg)	141.26 (66.28)[ab]	100.19 (72.43)[a]	128.08 (79.21)[ab]	161.66 (94.62)[b]	150.44 (77.36)[ab]	0,006†
Vitamin K (µg)	147.73 (183.05)[a]	55.34 (47.95)[b]	70.81 (109.85)[b]	90.04 (84.27)[ab]	120.00 (153.24)[ab]	0,061‡
Vitamin B_{12} (µg)	147.15 (282.23)[a]	62.71 (51.56)[b]	88.29 (48.02)[a]	123.03 (104.40)[a]	169.60 (227.83)[a]	<0.001‡
Niacin (mg)	201.27 (75.51)[a]	114.80 (91.58)[b]	139.01 (83.48)[bc]	146.88 (66.18)[b]	213.02 (120.26)[ac]	<0.001‡
Magnesium (mg)	96.18 (52.74)[a]	61.38 (31.73)[b]	86.25 (48.00)[ab]	95.88 (72.69)[ab]	101.51 (67.71)[ab]	0,003†
Phosphorus (mg)	213.12 (110.12)[a]	142.59 (101.65)[b]	199.57 (103.22)[a]	228.42 (157.74)[a]	264.10 (183.59)[a]	0,001‡
Potassium (mg)	54.35 (26.52)[a]	36.18 (15.83)[b]	48.12 (21.76)[a]	57.20 (37.59)[a]	57.59 (40.76)[a]	0,003‡
Sodyum (mg)	285.36 (158.94)[ac]	288.32 (724.35)[b]	314.43 (391.89)[ac]	303.23 (350.07)[a]	305.11 (182.25)[c]	<0.001‡

†Anova; ‡Friedman

Abbreviations: T0, pre-operation; T1, post-operation 1st week; T2, post-operation 2nd week; T3, post-operation 1st month; T4, post-operation 3rd month; EAR, estimated average requirement; AI, adequate intake

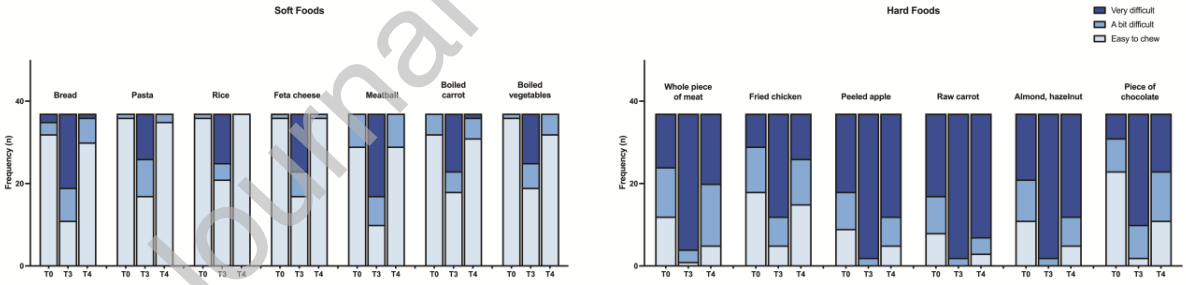


FIGURE 2 Changes in the ability of chewing foods according to timeline

Abbreviations: T0, pre-operation; T1, post-operation 1st week; T2, post-operation 2nd week; T3, post-operation 1st month; T4, post-operation 3rd month

Table 3: Comparison of total OHIP-14 score and subcategories across timeline

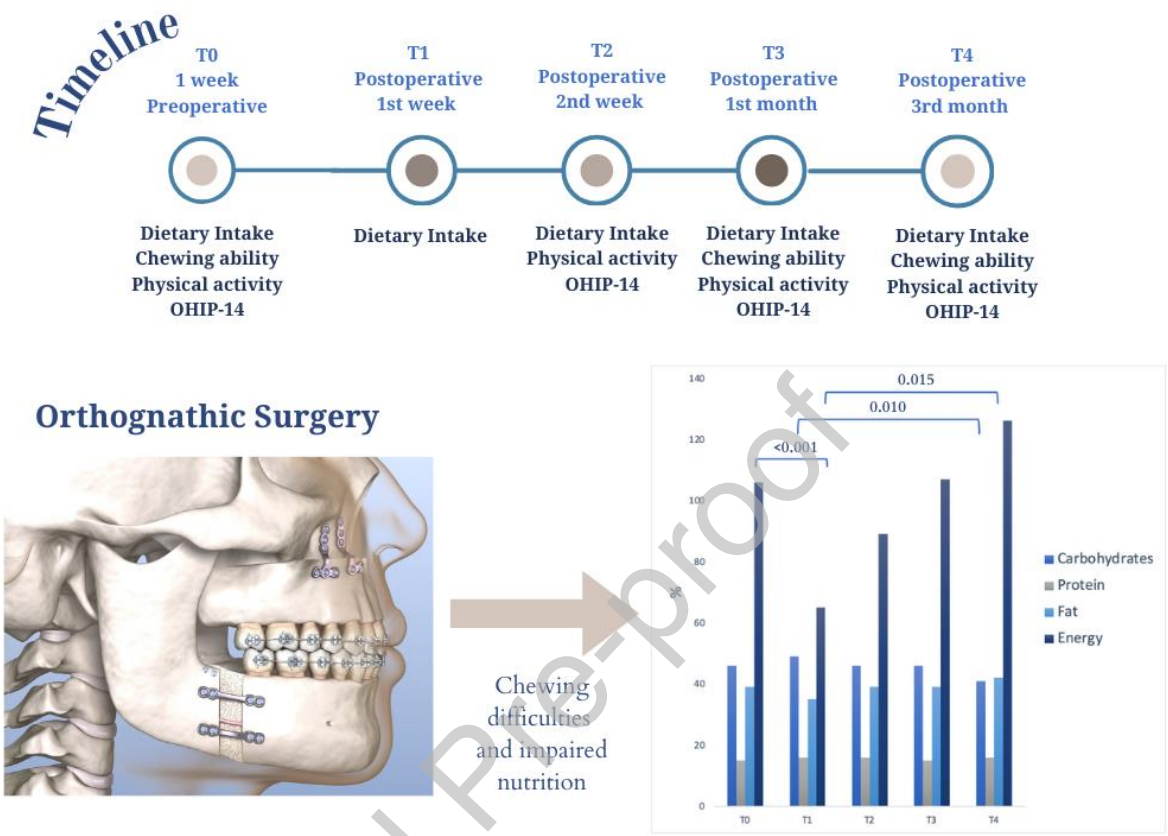
	T0	**T2**	**T3**	**T4**	***p* value**
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	
Functional Limitation	1.65 (1.42)[ac]	3.19 (1.79)[b]	2.51 (1.88)[ab]	1.62 (1.72)[c]	<0.001†
Physical Pain	2.24 (2.09)[ac]	4.24 (1.95)[b]	3.86 (2.21)[b]	2.78 (2.02)[c]	<0.001‡
Psychological Discomfort	4.03 (2.14)	4.41 (1.57)	4.19 (1.68)	4.16 (1.54)	0,705†

Physical Disability	1.49 (1.8)[a]	2.92 (2.13)[b]	2.35 (2.16)[ab]	1.57 (1.59)[a]	0,005‡
Psychological Disability	2.08 (2.17)	2.59 (1.85)	2.27 (2.41)	1.81 (1.85)	0,254‡
Social Disability	1.05 (1.29)[a]	2.89 (2.13)[b]	2.46 (2.19)[bc]	1.57 (1.63)[ac]	<0.001‡
Handicap	0.97 (1.38)	1.84 (1.76)	1.57 (1.76)	1.11 (1.45)	0,096‡
Total OHIP Score	13.54 (8.37)[a]	22.08 (9.46)[b]	19.22 (11.14)[b]	14.59 (9.52)[a]	<0.001†

†Anova; ‡Friedman

Abbreviations: T0, pre-operation; T1, post-operation 1st week; T2, post-operation 2nd week; T3, post-operation 1st month; T4, post-operation 3rd month

Graphical Abstract



Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: