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ORIGINAL ARTICLE

Evaluation of Nutritional Status and Eating Pattern in First and Second-Time Denture Wearers: A Prospective 60 Days (2 Months) Pilot Study

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Abstract Elderly individuals with extensive tooth loss preferentially consume soft, easier to chew foods which have a low nutrient density. The purpose of this study was to suggest that every complete denture wearer has to be periodically counseled by a registered Dietician and Dentist for check up to avoid malnutrition and disease. Fourteen patients were selected for this study. Seven of them with four or five teeth remaining without any functional units and seven patients who were known cases of complete denture wearers with ill-fitting or worn out dentures. The results of the study analyzed the change in eating pattern and hence the nutritional status of two groups of edentulous subjects; Group I (patients who underwent a recent transition from partially edentulous state to a completely edentulous state), and Group II (known complete denture wearers for five to ten years). Clinical examination of Group I showed an improvement, by, the decrease in percentages in both the paleness of the conjunctiva and nails of the selected patients. In Group II, there was a significant change in anthropometry and iron intake and the clinical examination showed positive changes in the patient's normal appearance, eyes and nails. Paired sample statistics between both the groups evaluated significant changes in energy, iron and vitamin C intakes in the dietary assessment chart. The general questionnaire assessment showed an improvement in the eating pattern of both the groups, which, may definitely account for a positive change in the nutritional status of the participants later. This study emphasizes that every complete denture wearer needs to be periodically counseled by a registered dietician and dentist for checkup to avoid malnutrition and disease.

Keywords Eating pattern · Nutritional status · Dietary assessment

Introduction

Dentitions, whether natural or artificial, are of paramount importance to ageing population. Decreased masticatory efficiency associated with tooth loss, is a prime age associated factor, which increases the risk of malnutrition and disease. The prosthodontic replacement of missing teeth with a removable partial or complete denture improves masticatory function and limits the risk of nutritional problems [1]. In 1965, Albert Yurkstas [2] stated that certain foods in the diet must be chewed before they can be swallowed comfortably. Frequently, elderly individuals with extensive tooth loss preferentially consume soft, easier to chew foods, which have a low nutrient density [3]. In 2002, Brian Hutton et al. [4] concluded in their review article that there is good evidence that edentulism is associated with poor diet and compromised nutrition. Diet and nutrition should be considered as an integral part of the oral health assessment and management of the elderly. This study was undertaken with two groups of patients, one group being first time denture wearers who had been transformed recently to a completely edentulous state and the other group being second time denture wearers who were not satisfied with their worn out dentures.

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Methodology

The objective of this study was to assess the nutritional status by assessing the eating patterns of two groups:

a. Those who underwent a recent transition from partially edentulous state to a completely edentulous state (Group I).
b. Those who are already known complete denture wearers for 5–10 years who reported for new dentures due to their ill-fitting or worn out old dentures (Group II).

The study employed the following parameters to assess the nutritional status of the abovementioned groups [5]. It consisted of the following:

a. General information of the individuals
b. Anthropometric records
c. Biochemical evaluation
d. Clinical examination
e. Dietary recall method (i.e., 24 h)

Fourteen patients were selected for this study; seven of them with reduced dentition with no functional units and seven patients were complete denture wearers with ill-fitting or worn out dentures. The control group comprised of the seven partially edentulous patients, before their teeth were extracted.

Four males and ten females participated in this study. The age group selected for this study design was between 40 and 60 years. The selected individuals were healthy and did not suffer from any form of systemic disorder. All participants were nonalcoholic and nonsmokers. The procedures followed were in accordance with the ethical standards and clearance was obtained from the Indian Council of Medical Research. There is an ongoing research on food guide pyramids with this study.

General Information

General information of the individuals was recorded, which comprised of name, age, gender, date of visit, education, occupation, economic status, habits if any, all of which helped in the selection of the patients to be used for the study.

Anthropometric Records

The following parameters were recorded for both Groups I and II:

a. Height of the patient in meters.
b. Weight of the patient in kilograms, before and after treatment procedures.
c. Body mass index (BMI)

Biochemical Evaluation

This consisted of estimation of serum albumin and hemoglobin percentage to deduce the nutritional status in the blood level before and after treatment procedures in both Group I and Group II [6].

In 1999, Jorgensen et al. [7] assessed the nutritional status using serum albumin concentration and BMI.

Clinical Examination [6]

Clinical examination indicates common physical signs of deficiency due to poor eating pattern which is caused by the loss of teeth. These signs are evaluated before and after the treatment procedure:

a) Before complete denture fabrication
b) After fabrication of new complete dentures, post insertion adjustment and a 2 month follow-up in both Groups I and II.

The commonest signs are skin changes, pale nails, conjunctiva, tongue, fissured lips, ulcers, and muscle wasting.

Dietary Recall Method

This session involved an evaluation with a general questionnaire I along with a 24 h dietary recall. The general questionnaire is given as questionnaire I.

Questionnaire I

Assessment of eating pattern and nutritional status of the chosen individuals:

Name	
Age	
Sex	
Date of visit	I Visit:
	II Visit:
Social history	
Education	
Occupation	
Economic status	
Appetite	
Bowel	
Micturition	
Thirst	
Sleep	
Height	
Current weight	
Body mass index	I Visit:
	II Visit:

Clinical examination/head to toe assessment/review of the system [6]

a General appearance
Normal
Fatigued
b Eyes
Normal
Pale
c Nails
Normal
Pale
d Skin
Normal
Dry
e Lips
Normal
Fissured
1 What is your current appetite?
1. Good
2. Poor
2 Has your appetite or food intake been less than usual?
1. No
2. Yes
3 Do you have tooth, mouth or swallowing problems that makes it hard for you to eat?
1. No
2. Yes
4 Do you regularly skip meals?
1. No
2. Yes
5 Do you have any allergies or intolerances for food?
1. No
2. Yes
6 Do you have any illness or condition that made you change the kind and amount of food you eat?
1. No
2. Yes
7 Selected consumption markers for protein intake
- At least one serving of dairy products/day (milk, curds, butter milk, paneer, cheese, yoghurt)
1. Yes
2. No
- Two or more servings of meat, fish, poultry, eggs/week
1. Yes
2. No
- Legumes, pulses every day
1. Yes
2. No
1. If only non-vegetarian items were excluded
2. If legumes, pulses were also excluded
3. If only one of the three are emphasized
8 Do you consume two or more servings of fruits or vegetables/day?
1. Yes
2. No
9 How many medications prescribed by your doctor or brought over the counter are you taking?
0–2 → 1
>3 → 2
Self view of nutritional status
1. Views as having no nutritional problems (normal)
2. Views as being undernourished
10 Have you suffered any psychological stress due to your partially edentulous condition?
1. No
2. Yes.

An evaluation was done before the prosthodontic management was scheduled. To identify the exact eating behavior with regard to the ability to chew, frequency and type of food intake, questionnaire II [8] was used along with questionnaire I and the differences if any were recorded. A 24 h dietary recall after prosthodontic treatment was also recorded

Questionnaire II

1 Do you have pain (localized) after wearing the complete denture?
2 Do you have any generalized pain after wearing the complete denture?
3 Any looseness of the denture?
4 Do you feel that your denture is cosmetically not satisfactory?
5 Do you have speech problems with your denture?
6 Do you feel a gagging reflex after wearing the denture?
7 Do you have any eating difficulties?
8 Do you have any tongue biting or cheek biting after wearing the denture?
9 Do you have commissural cheilitis or clicking after wearing the denture?
10 Do you have any limitation of mandibular movement?

Complete Denture Fabrication

The first group of patients who had a few teeth remaining was scheduled for multiple extractions. The second group of patients who were known to be complete denture wearers was directly scheduled for prosthodontic management.

Complete dentures were fabricated for both Group I and II patients [9].

The dietary intake before and after treatment procedures in both the groups were calculated by the recommended

Software package system (Annapurna Software Package, MR, Chandrashekara Associates; Bangalore).

In this software the name of the food item and the quantity of each food item in grams, are entered into the computer and the results are obtained in the form of calories for the different types of food. This shows the amount of calorie intake of protein, fat, energy, calcium, vitamin C and iron in 24 h before and after complete denture treatment in the Groups, I and II.

Results and Statistical Analysis

The results of the study, which analyzed the change in eating pattern, and hence the nutritional status of Group I and Group II edentulous subjects are given below Table 1:

From this table, it is evident that two individuals showed no change in their weight and BMI, before and after treatment. The remaining three, showed a decrease in their weight and BMI after treatment. Of the seven subjects who participated in Group I, four showed an increase in serum albumin levels. Of the seven individuals who participated in Group I, three showed an increase in the hemoglobin percentage.

Paired sample statistical analysis (student "*t*" test) was carried out by the SPSS (Statistical Package of Social Sciences) Software system which is shown in Tables 2 and 3.

Group I individuals showed no difference between the before and after of dental treatment in anthropometric, and biochemical measures.

Table 2 gives the height and weight of the subjects belonging to the second group. The body mass index measured before and after treatment for the Group II individuals is given in Table 4. The serum albumin and hemoglobin which are the markers of protein and the nutritional status can also be found in Table 4. These markers were recorded before and after treatment of Group II individuals.

From this table, it is evident that, four out of the seven individuals of Group II who participated in this study exhibited a weight again after the treatment with complete dentures. This weight gain resulted in a corresponding increase in the body mass index. The remaining three of the individuals, showed no change in their weight and BMI, before and after treatment. Of the seven subjects who participated in Group II, four showed an increase in serum albumin levels. Of the seven individuals who participated in Group II, three showed an increase in the hemoglobin percentage.

Statistical analysis in Group II showed, a 5% difference between the before and after treatment, in the anthropometric measure and no significance in parameters of serum albumin and hemoglobin percentages. This is shown in Tables 5 and 6.

On comparing the anthropometric and biochemical parameters by statistical analysis, in both Groups I & II, no significant difference was observed before and after treatment in these groups. This is shown in Tables 7 and 8.

Pretreatment and post-treatment clinical examination between Group I and Group II individuals was carried out

Table 1 Results of anthropometric and biochemical parameters before and after treatment in Group I subjects

S. no.	Height (m)	Weight (Kg)		Body mass index (BMI)		Serum albumin (g/dl)		Hemoglobin (g%)	
		Before	After	Before	After	Before	After	Before	After
1.	1.68	90	90.5	31.88	32.06	4.0	4.1	15.2	15.2
2.	1.50	40	39.5	26.66	26.33	4.3	3.9	11.7	13.6
3.	1.50	52	52	23.11	23.11	3.6	3.9	12.0	12.0
4.	1.62	48	46	18.29	17.53	4.4	4	14.2	14.0
5.	1.62	60	54	22.86	20.57	3.5	4.3	11.4	11.4
6.	1.58	53	59	21.23	23.63	3.5	3.6	10.6	11
7.	1.54	51	51	21.50	21.50	4.5	4.5	11.7	12

Table 2 Comparison of the anthropometric measures before and after dental treatment in Group I only

	Mean	*N*	SD	Std. error mean	*t*	Level of significance
Weight						
Before	56.285	7	16.028	6.058	0.212	NS
After	56.000	7	16.413	6.203		
Body mass index						
Before	23.647	7	4.414	1.668	0.217	NS
After	23.532	7	4.648	1.757		

Table 3 Comparison of the blood parameters before and after dental treatment in Group I only

	Mean	*N*	SD	Std. error mean	*t*	Level of significance
Serum albumin						
Before	3.971	7	0.4386	0.1658	0.455	NS
After	4.042	7	0.2936	0.1110		
Hemoglobin (%)						
Before	12.400	7	1.6563	0.6260	1.267	NS
After	12.742	7	1.5437	0.5834		

Table 4 Results of anthropometric and biochemical parameters before and after treatment of Group II subjects

S. no.	Height (m)	Weight (Kg)		Body mass index (BMI)		Serum albumin (g/dl)		Hemoglobin (g%)	
		Before	After	Before	After	Before	After	Before	After
1.	1.58	59	60	23.63	24.03	4.2	4.0	12.0	14.1
2.	1.69	60	60	21.007	21.007	3.6	3.5	15.2	15.0
3.	1.64	55	55	20.449	20.449	3.6	3.7	11.7	11.5
4.	1.58	63	64	25.23	25.63	3.4	3.6	11.2	11.2
5.	1.51	50	51	21.92	22.36	4.2	4.3	7.2	8.1
6.	1.48	51	51	23.283	23.283	4.4	3.8	11	10
7.	1.5	55	56	24.44	24.88	4.6	4.8	11.4	12.0

Table 5 Comparison of the anthropometric measures before and after dental treatment in Group II only

	Mean	*N*	SD	Std. error mean	*t*	Level of significance (%)
Weight						
Before	56.142	7	4.775	1.805	2.828	5
After	56.714	7	4.889	1.847		
Body mass index						
Before	22.851	7	1.780	0.672	2.821	5
After	23.091	7	1.933	0.730		

Table 6 Comparison of the biochemical parameters before and after dental treatment in Group II only

	Mean	*N*	SD	Std. error mean	*t*	Level of significance
Serum albumin						
Before	4.000	7	0.4619	0.1746	1.291	NS
After	3.814	7	0.2673	0.1010		
Hemoglobin (%)						
Before	11.385	7	2.3355	0.8828	1.133	NS
After	11.771	7	2.2874	0.8646		

using a questionnaire and the results are given in Table 9. The parameters of clinical examination were calculated on percentage basis for the individuals groups.

The quality, quantity and frequency (i.e., eating pattern) of food taken before and after treatment was analyzed using a general questionnaire for both Group I and Group II subjects.

Table 10 gives the contents of the general questionnaire and the scoring scale.

Along with the general questionnaire, a dental questionnaire was also included to assess the comfort of the newly made complete dentures in both Groups I and II. The results of the dental questionnaire are given in Table 11.

Table 7 Comparison of the anthropometric measures before and after dental treatment in both Groups I and II

Group	Mean	*N*	SD	Std. error mean	*t*	Level of significance
Weight (Kg)						
Before	56.214	14	11.362	3.036	0.215	NS
After	56.357	14	11.641	3.1112		
Body mass index						
Before	23.244	14	3.259	0.8712	0.241	NS
After	23.312	14	3.428	0.9162		

Table 8 Comparison of the blood parameters before and after dental treatment in both Groups I and II

	Mean	*N*	SD	Std. error mean	*t*	Level of significance
Serum albumin (g/dl)						
Before	3.9857	14	0.4330	0.1157	0.528	NS
After	3.9286	14	0.2946	7.875 E-02		
Hemoglobin (%)						
Before	11.892	14	2.015	0.5386	1.743	NS
After	12.257	14	1.941	0.5188		

Table 9 Results of clinical examination before and after treatment in Group I and Group II subjects

	Group I		Group II	
	Pre (%)	Post (%)	Pre (%)	Post (%)
General appearance				
Normal	85.7	85.7	57.1	100
Fatigued	14.3	14.3	42.9	–
Eyes				
Normal	–	57.1	71.4	100
Pale	100	42.9	28.6	–
Nails				
Normal	28.6	57.1	14.3	100
Pale	71.4	42.9	85.7	–
Skin				
Normal	100	100	100	100
Dry	–	–	–	–
Lips				
Normal	100	100	100	100
Fissured	–	–	–	–

The comparative analysis in the dietary parameters, before and after treatment for Group I and Group II are shown in Table 12.

Discussion

Dietary habits and nutrient intake are important throughout life, especially for elderly people, in whom nutritional deficiencies may contribute to increased morbidity and premature death. A decrease in quantity and quality of food consumed, leads to decreased energy and nutrient intake and subsequently, to malnutrition. Malnutrition, in turn is associated with a decrease in functional skills, increased susceptibility to infection and higher mortality [10]. Numerous studies have found that fewer remaining teeth, edentulism, poor masticatory function and other oral problems are associated with decreased nutrient intake.

This study compared the eating pattern and the nutritional status before and after treatment in first and second time denture wearers.

Table 10 Results of the general questionnaire before and after treatment in Group I and Group II subjects

S. no.	General questionnaire I	Scoring scale	Group I		Group II	
			Pre (%)	Post (%)	Pre (%)	Post (%)
1.	Current appetite	1. Yes	85.7	85.7	42.9	71.4
		2. No	14.3	14.3	57.1	28.6
2.	Less food intake	1. No	57.1	71.4	28.6	57.1
		2. Yes	42.9	28.6	71.4	42.9
3.	Tooth or mouth problems	1. No	57.1	85.7	14.3	42.9
		2. Yes	42.9	14.3	85.7	57.1
4.	Skip meals	1. No	57.1	85.7	71.4	85.7
		2. Yes	42.9	14.3	28.6	14.3
5.	Allergies	1. No	57.1	71.4	100	100
		2. Yes	42.9	28.6	0	0
6.	Change in the kind of food due to illness.	1. No	14.3	85.7	85.7	100
		2. Yes	85.7	14.3	14.3	0
7.	Change in the amount of food	1. No	42.9	85.7	0	100
		2. Yes	57.1	14.3	100	0
8.	Consumption marker of protein intake	1. Only veg. items	42.9	57.1	0	100
		2. Legumes pulses also were excluded	14.3	14.3	0	0
		3. Only one of the three are emphasized	42.9	28.6	100	0
9.	Fruits and vegetables	1. Yes	85.7	85.7	0	100
		2. No	14.3	14.3	100	0
10.	Medications	1	85.7	85.7	100	100
		2	14.3	14.3	0	0
11.	Self-view of nutritional status	1. Yes (normal)	85.7	85.7	0	100
		2. No	14.3	14.3	100	0
12.	Psychological stress (normal)	1. Yes (normal)	42.9	71.4	100	100
		2. No	57.1	28.6	0	0

A total of fourteen patients were selected for this study; seven in Group I and seven in Group II and complete dentures were fabricated for all the patients using standardized procedures.

In this study, assessment of the nutritional status, using, serum albumin concentration and body mass index was done.

Paired sample statistics was evaluated in Group I, Group II, & Group I & II together for the anthropometric, biochemical, and dietary parameters.

In Group I, there was no significant change in anthropometric biochemical and dietary parameters. This was mainly due to the fact that, first time denture wearers were subjected to prosthesis for the first time. They therefore took a longer time for acclimatization of the dentures and hence were not able to record any improvement in the above mentioned parameters. However, clinical examination showed that paleness of conjunctiva and nails before and after treatment changed from 100 to 43% and 71 to 43%, respectively.

The general questionnaire evaluated before and after treatment procedures showed that there was an increase in the quality, quantity and frequency of food intake (i.e., eating pattern). However, there was no change in the current appetite and fruits and vegetable intake in these individuals. It must be noted that in Group I, 57% of them complained of psychological stress due to tooth loss in contrast to none of the patients in Group II.

In Group II, paired statistics showed a 5% significant change in anthropometric measure and iron intake. It also showed a decrease in the percentages of, paleness of conjunctiva and nails from 29 to 0% and 86 to 0%, respectively. The general questionnaire was also evaluated in Group II. It showed that there was an improvement in the eating pattern of the food intake, giving more importance to the form and amount of fruits, vegetables and protein markers' intake.

Since the scope of the final assessment was limited to sixty days, the study predominantly showed changes in the eating pattern. Hence it can be inferred that a longer

Table 11 Results of the dental questionnaire (questionnaire II) before and after treatment in Group I and Group II subjects

S. No.	Dental questions	First group		Second group	
		Yes	Percentage	Yes	Percentage
1.	Localized pain	2	28.57	0	0.00
2.	Generalized pain	0	0.00	0	0.00
3.	Looseness of denture	1	14.28	0	0.00
4.	Cosmetically not satisfactory	0	0.00	1	14.28
5.	Speech problems	0	0.00	2	28.57
6.	Gagging reflex	3	42.85	0	0.00
7.	Eating difficulties	2	28.57	0	0.00
8.	Tongue biting or cheek biting	0	0.00	0	0.00
9.	Commissural cheilitis	0	0.00	0	0.00
10.	Limitation of mandibular movements	0	0.00	0	0.00

Table 12 Comparison of the dietary parameters before and after dental treatment in both Groups I and II

Nutrient		Mean	*N*	SD	Std. error mean	*t*	Level of significance
Energy (kcal)	Before	1161.897	14	216.6585	57.904	2.344	5%
	After	1423.912	14	445.6190	119.096		
Protein (g)	Before	36.8771	14	8.9421	2.3899	1.318	NS
	After	49.3343	14	33.9529	9.0743		
Fat (g)	Before	34.8500	14	8.9421	2.3899	1.259	NS
	After	41.6350	14	20.125	5.3787		
Calcium (mg)	Before	546.7057	14	186.874	49.944	1.676	NS
	After	701.2779	14	364.127	97.317		
Iron (mg)	Before	10.8257	14	3.434	0.9180	2.999	1%
	After	15.0279	14	6.038	1.6139		
Vitamin C (mg)	Before	48.117	14	28.606	7.645	2.816	1%
	After	83.3521	14	62.352	16.664		

follow-up period of 1–2 years may show improvement in the nutritional status of Group I and many other parameters of Group II.

When paired sample statistics was evaluated between Groups I & II, it showed that there was a 5% significant change in the energy intake before and after treatment and 1% significance in iron and vitamin C intakes.

All these above facts show, that edentulism can substantially affect oral health as well as the overall quality of life.

It is possible that compromised dental function results in the swallowing of poorly chewed food, food avoidance patterns, dietary inadequacies, and systemic changes favoring illness, reduced vigor, debilitation and shortened life expectancy.

Conclusion

The present study was undertaken to study the eating pattern and evaluate the nutritional status with two different groups. Both groups were given a pair of complete dentures, constructed in a standardized manner, and after a follow-up period of 60 days, the assessments were recorded again as post-treatment records.

Clinical examination of Group I showed an improvement by the decrease in percentages in both the paleness of the conjunctiva and nails of the selected patients.

In Group II, a significant change was noted in anthropometry and iron intake and the clinical examination showed positive changes in the patient's normal appearance, eyes and nails. Paired sample statistics between both the groups evaluated significant changes in energy, iron and vitamin C intakes in the dietary assessment chart.

The general questionnaire assessment showed an improvement in the eating pattern of both the groups.

Changes in the anthropometric, clinical and certain dietary parameters were found in the patients after dental treatment in a follow-up period of 2 months. Changes in the other parameters may be found if further study is

conducted for a longer follow-up period, and, with more number of participants.

In conclusion, this study emphasized that every complete denture wearer needs to be periodically counseled by a registered dietician and dentist for checkup to avoid malnutrition and disease.

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