

Does Prosthodontic Treatment Improve the Nutrition Status in the Elderly? Literature Review

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Received November 24, 2021; Revised December 29, 2021; Accepted January 07, 2022

Abstract Prosthodontic treatment is performed to improve esthetics and oral function. That is, mastication and speech as a primary function, and finally for nutritional requirements, especially in the elderly. This literature review was conducted to evaluate the treatment outcomes of prosthodontic treatment for the elderly with two nutritional hypotheses: 1) prosthodontic intervention improves the diversity of food intake, and 2) prosthodontic intervention improves nutritional status. There is weak evidence that prosthodontic treatment can improve dietary intake; however, it could affect less the nutritional condition in comparatively healthy elderly individuals. The combination of prosthodontic treatment and nutritional guidance demonstrated nutrient intake efficiency.

Keywords: *prosthodontic treatment, oral function, elderly, nutrition, food intake*

Cite This Article: Tetsuo Ichikawa, Takaharu Goto, Takahiro Kishimoto, Yuichi Ishida, and Megumi Watanabe, "Does Prosthodontic Treatment Improve the Nutrition Status in the Elderly? Literature Review." *Journal of Food and Nutrition Research*, vol. 10, no. 1 (2022): 26-31. doi: 10.12691/jfnr-10-1-4.

1. Introduction

The glossary of prosthodontic terms defines prosthodontics as the dental specialty pertaining to the diagnosis, treatment planning, rehabilitation, and maintenance of the oral function, comfort, appearance, and health of patients with clinical conditions associated with missing or deficient teeth and/or maxillofacial tissues by using biocompatible substitutes [1]. Oral function mainly includes mastication. Mastication is the initial process of digestion and nutritional intake. Food intake from the oral cavity is also a great desire, especially in the elderly, and involves human dignity.

With the increase in the elderly population worldwide, the concept of frailty in the elderly has been proposed and has become popular [2,3]. Undernutrition/malnutrition is a key element of physical frailty and sarcopenia [4,5]. Although there are numerous causes of undernutrition/malnutrition, difficulty in mastication owing to tooth loss and denture disorder is a major factor [6,7]. Prosthodontic treatment is expected to improve masticatory disorders and facilitate the intake of various foods through the oral cavity. Several methods have been proposed as outcomes following prosthodontic treatment: subjective satisfaction using a visual analog scale, questionnaires on the ease of chewing food, maximum occlusal force, and chewing efficiency using gummy jelly [8,9,10]. Further downstream outcomes following mastication have been addressed: whether nutrient intake

becomes more appropriate as a result of prosthodontic intervention and whether the nutritional requirement of the patient becomes more appropriate.

Considering the importance of undernutrition/malnutrition in the elderly, the efficacy of prosthodontic treatment needs to be discussed with outcomes such as nutrition and systemic health conditions. Although several studies on the relationship between prosthodontic interventions and nutrition have been conducted, insufficient and conflicting results have been found.

This literature review was conducted to evaluate the treatment outcomes of prosthodontic treatment for the elderly with two nutritional hypotheses: 1) prosthodontic intervention improves the diversity of food intake, and 2) prosthodontic intervention improves the nutritional condition.

2. Material and Methods

2.1. Information Sources and Search

English language articles published between January 1980 and December 2020 were reviewed using the MEDLINE database (via PubMed). Electronic database searches were performed using keywords and MeSH terms based on a search strategy used for searching MEDLINE (via PubMed): (nutrition) AND ((dental prosthesis [MeSH Terms]) or (dental implant [MeSH Terms])). In addition to these database searches, manual searches were performed.

2.2. Inclusion Criteria

The articles were selected based on the following inclusion criteria: 1) prosthodontic intervention or dental arch condition are described, 2) articles with dietary intake assessments or nutritional outcomes, such as body mass index (BMI), minimum nutrition assessment (MNA), and blood markers; 3) cross-sectional study, cohort study, randomized controlled trials (RCTs), and literature review studies; and 4) full-text articles in English. Moreover, the exclusion criteria were *in vitro* and animal studies.

2.3. Study Selection

A literature search was performed in this study. Two authors (T. I. and T.G.) who had previously determined the criteria, independently evaluated the literature search.

First, the collected titles and abstracts were selected based on the aim and criteria. Furthermore, two reviewers confirmed that the results were the same; then, those articles underwent full-text reading to check further if detailed information was reported. Finally, the effects of both dietary intake and nutritional status were evaluated by the two authors based on the following:

“not supported” indicates that there is no evidence on the effect.

“conflicting” indicates that the results on the effect are conflicting.

“supported” indicates that the papers support that the prosthodontic intervention/oral health is effective.

3. Results

After the initial screening of the titles and abstracts, 23 original studies [11-33] and 16 review studies [34-49] were finally selected, and the nutritional effects of the prosthodontic interventions/dental arch conditions were discussed. The results of the 23 original studies and 16 review studies are summarized in Table 1 and Table 2, respectively. The table on the original articles contains the author names, publication year, research type, subject number and age, follow-up period, prosthodontic intervention and comparison, effects on the dietary intake and nutritional status, and main suggestions. The table on the review articles contains the author names, publication year, research type, prosthodontic intervention/target, effects on dietary intake and nutritional status, and main suggestions.

BMI, MNA, and some blood biomarkers are often used in nutritional assessments, and dietary intake is used as an indirect nutritional assessment. The Oral Health Impact Profile (OHIP), masticatory efficiency, and masticatory satisfaction were used to assess oral health and masticatory ability. The relationship between the missing teeth number/functional teeth number and nutritional status was examined in a cross-sectional study. Cohort studies were also conducted to compare the nutritional outcomes before and after prosthodontic treatment. Randomized controlled trials (RCTs) were used to compare the outcomes between the implant prostheses and conventional removable dentures.

Table 1. Results of original papers

No.	Authors	Year	Research type	Subjects No.	Age	Follow-up period	Intervention	Comparison	Effects	
									Dietary intakes	Nutritional status
1	Olivier	1995	Cohort	55-74	55	3w, 6-9m	denture relining +NG			
2	Sebring	1995	Comparative study	71	around 60	3.5y	ID(41)	CD(30)		
3	Moynihan	2000	RCTs	60		3m, 12m	SDA(30)	PD(30)		
4	Hamada	2001	Cohort	89	diabetic edentulism	6m	IOD(52) CD(37)			
5	Sheiham	2001	Comparative study	753 (Home), 196 (NH)	>65					
6	Sheiham	2002	Cross-sectional	629	>65					
7	Morais	2003	Cohort	60	65-75	6m	IOD(30)	CD(30)		
8	Bradbury	2006	RCTs	58	65-66	6w	CD(30)+DC	CD(28)		
9	Wöstmann	2008	Cohort	47(NH)	>60	6m	Denture intervention			
10	Muller	2008	RCTs	53	53	1y	IOD	CD		
11	Lee	2010	Cross-sectional	3611	>60					
12	Borges	2011	Cohort	16	59.2	3m, 6m	CD -> IOD	before/after		
13	McKenna	2012	RCTs	44	>65	1m	SDA(23)	RPD(21)		
14	Awad	2012	RCTs	255	>65	6m, 1y	IOD(128)	CD(127)		
15	Müller	2013	RCTs	34	84-85	1y	IOD(16)	CD(18)		
16	Hamdan	2013	RCTs	217	>65	1y	IOD(103)	CD(114)		
17	Tajbakhsh	2013	Cohort	32	58	5y	CD -> IFPD	before/after		
18	McKenna	2014	RCTs	132	>65	6m, 12m	RPD(65)	SDA(67)		
19	Gonçalves	2015	Crossover	12	62.6	3 days	IFPD vs RPD	before /after		
20	Elsig	2015	Cross-sectional	29 dementia, 22 normal, 3 cognitive decline	>75					
21	Tanasić	2016	Cohort	200	68.9	1y	RPD			
22	Amagai	2017	RCTs	62	77	3M	CD+NG (31)	CD(31)		
23	Wallace	2018	RCTs	89	>65	1y	RPD(44)	SDA(45)		

NH: Nursing home residents
NG: nutritional guidance

RPD: Removable partial denture
CD: Complete denture
IOD: Implant-supported overdenture
IFPD: Implant fixed partial denture
SDA: Shortened dental arch

Not supported
Conflicting
Supported

No.	Authors	Year	Nutritional results
1	Olivier	1995	Reduce the presence of digestive symptoms. Fiber intake from vegetables was significantly increased
2	Sebring	1995	No significant differences in intake of calories or of 27 nutrients were noted between the two groups .
3	Moynihan	2000	Prosthetic rehabilitation did not result in any other change in the intake of nutrients or in the amount of fruits and vegetables consumed.
4	Hamada	2001	The replacement of old dentures with new dentures that included either a mandibular CD or IOD did not alter patient diets such that the patients improved their nutritional intakes of essential micronutrients and macronutrients.
5	Sheiham	2001	The presence, number and distribution of natural teeth are related to the ability to eat certain foods, affecting nutrient intakes and two biochemical measures of nutritional status.
6	Sheiham	2002	People without teeth were significantly more likely to be underweight than those with 11 or more teeth.
7	Morais	2003	Significant increases were seen in concentrations of serum albumin, hemoglobin, and B12. No significant between-group differences were found. Body measurements were improved in IOD.
8	Bradbury	2006	Greater increase in fruit/vegetable consumption
9	Wöstmann	2008	Despite the highly significant improvement in masticatory ability, no general improvement regarding the nutritional status was observed since the albumin, zinc and MNA values remained unchanged and pre-albumin even decreased.
10	Muller	2008	CD wearers reported having more difficulty in chewing hard foods, both groups appeared to have a similar nutritional status (Body composition, plasma parameters, food intake)
11	Lee	2010	Systolic blood pressure, CHOL, FPG, and HB in males were statistically significant after adjusting for age and smoking. In females, systolic blood pressure, CHOL, FPG, and BMI were positively associated with the number of missing teeth.
12	Borges	2011	Improvement in masticatory performance and nutritional condition.
13	McKenna	2012	Both prosthodontic rehabilitation resulted in an improvement in MNA score. Blood markers did not illustrate a clear picture of improvement in nutritional status.
14	Awad	2012	No positive effect on the nutritional state (blood plasma levels of homocysteine (tHcy), vitamin B12, vitamin B6, albumin, serum folate, and C-reactive protein).
15	Müller	2013	BMI decreased in both groups, but the decline tended to be smaller in the intervention group; blood markers and the MNA did not confirm this tendency. IODs are significantly more likely to take in their nutrients through fresh, whole fruits and vegetables.
16	Hamdan	2013	Total dietary fiber (TDF), macronutrients, 9 micronutrients, and energy in diets. No significant between-group differences were found
17	Tajbakhsh	2013	Vegetable intake and ability to masticate raw, hard, and fibrous food improved
18	McKenna	2014	Biochemical markers (serum Albumin and Cholesterol, Ferritin, Folate, Vitamin B12 and D). The only measure which illustrated consistent significant improvements in nutritional status for either group were Vitamin D. No difference was recorded between two groups.
19	Gonçalves	2015	Higher intake of fiber, calcium, and iron and lower consumption of cholesterol-rich food
20	Elsig	2015	Neither dental state nor chewing efficiency was related to the nutritional state.
21	Tanasić	2016	Adequate oral rehabilitation with symmetric positioning of the functional tooth units can improve the nutritional status (MNA, BMI) of partially edentulous patients.
22	Amagai	2017	Simple dietary advice combined with complete denture treatment could improve food intake of edentulous patients.
23	Wallace	2018	Masticatory performance may only have minor associations with nutritional status for this patient group. No difference of nutritional status (MNA, blood marker) was found in two groups. Further research is required to determine the impact of oral rehabilitation coupled with nutritional counseling for this patient population.

Table 2. Results of review papers

No.	Authors	Year	Intervention/Target	Effects		Suggestions
				Dietary intakes	Nutritional status	
1	Budtz-Jørgensen	2000	Prosthodontic intervention			There is no evidence that the provision of prosthetic therapies can markedly improve dietary intakes.
2	Budtz-Jørgensen	2001	Prosthodontic intervention			Maintenance or re-establishment of masticatory function is an integral part of the medical health care of these patients, with the aim of improving their nutritional status and quality of life.
3	Ritchie	2002	Oral health			Tooth loss affects dietary quality and nutrient intake in a manner that may increase the risk for several systemic diseases, but there is a paucity of well-designed studies addressing oral health and nutrition.
4	Sánchez-Ayala	2010	IOD vs RPD			The effect on the nutritional state in edentulous subjects treated with implant therapy is similar to the one obtained with conventional removable dentures.
5	Preshaw	2011	RPD			There is no evidence to support a negative impact on nutritional status.
6	Van Lancker	2012	Oral health in elderly			Tentative evidence indicates an independent association between oral health status and malnutrition in the elderly residing in a long-term care facility.
7	Tamura	2013	Oral health			In 16 studies. MNA, BMI, other standard measures of malnutrition. Potentially modifiable factors consistently associated with increased likelihood of weight loss, low BMI, or poor nutrition included depression, impaired function, and poor oral intake.
8	Tada	2014	Oral health			In 22 of 28 studies, elderly persons with better mastication and dentition reported significantly higher consumption of foods and intake of some nutrients than those with poorer oral health; 6 studies showed no such differences. 5 of the 7 intervention studies did not show significant improvement in food and/or nutrient intake.
9	Boven	2015	IOD vs CD			Chewing efficiency, maximum bite force, and satisfaction are improved. The effect on QoL is uncertain, and there is no effect on nutritional state.

No.	Authors	Year	Intervention/Target	Effects		Suggestions
				Dietary intakes	Nutritional status	
10	Yamazaki	2016	IOD vs CD			BMI, albumin, and B12 were not changed. The modifying effect of overdenture treatment on nutritional status might be limited
11	Gaewkhiew	2017	Oral health			There is at present no strong evidence on the effect of tooth loss on diet and nutrition, with inconsistent results among the few studies identified.
12	Kroll	2018	IOD vs CD			Patients' general satisfaction, oral health-related quality of life, and chewing ability were improved. Nutritional status in blood level except vitamin B12 blood levels were not changed for one year.
13	Kossioni.	2018	Prosthodontic intervention			Prosthetic rehabilitation of missing teeth, when accompanied by dietary counselling, may improve dietary habits and nutritional intake. But this only partly contributes to food choices and nutritional status.
14	Toniazzo	2018	Oral health			Well-nourished subjects had a significantly higher number of pairs of teeth/Functional Teeth Units (FTU) in comparison to individuals with risk of malnutrition or malnutrition.
15	Watanabe	2020	Oral health			Decreased oral function is a major risk factor for developing malnutrition.
16	McGowan	2020	Oral health			Support for dietary intervention coupled with oral rehabilitation on diet
RPD: removable partial denture				Not supported		
CD: complete denture				Conflicting		
IOD: Implant-supported overdenture				Supported		

In the original study, the first hypothesis was supported by many studies, especially how the combination of prosthodontic treatment and nutritional guidance improved the diversity of food intake. The second hypothesis was supported by some older studies but more recent studies tended to be less supportive.

In this review, there were many articles in which oral health status was related to the conditions of nutrition and frailty, which supported our hypothesis. However, the findings do not always show that it is the cause (chicken) or the effect (egg) with oral health status and the conditions of nutrition and frailty. Considering the effects of prosthodontic treatment, the first hypothesis is almost accepted; however, the second hypothesis is not.

4. Discussion

In this review, original papers and review papers were extracted since many conflicting opinions on the hypotheses were anticipated. It was intended to increase the reliability when providing answers to the hypotheses.

Several studies have investigated the effects of prosthodontic intervention on nutritional conditions, including the diversity of food intake. This includes whether prosthodontic treatments provide diversity in food intake, whereby individuals can eat any food to obtain the appropriate nutrients and thus improve their nutritional status.

Most reports have shown improvements in satisfaction, quality of life, and chewing ability following conventional prosthodontic treatments and implant-supported denture delivery. Although such prosthodontic treatments facilitated diversity in food intake, patients wearing conventional dentures did not necessarily avoid specific types of food compared to patients wearing implant-supported dentures with higher masticatory efficiency [12,20,26]. This may be supported by the results of Fujimoto et al. [50], who reported that subjective masticatory satisfaction rather than objective masticatory efficiency reflected a higher BMI. This may be because

the patients consumed any type of food through appropriate cooking methods.

Considering the improvement of nutritional status following prosthodontic interventions, some studies reported improvements [17,22,23,31,35]; however, most studies did not always report significant improvement [14,19,20,24,25,26,28,30,33,37,38,42,43,45,46]. Patients who have undergone prosthodontic treatment, including implant treatments, generally have good general health conditions without any hyponutrition/malnutrition, and prosthodontic treatments might be needed to obtain higher satisfaction with mastication. Consequently, the treatment might have had less effect on the nutritional condition of the elderly.

When prosthodontic treatment was combined with dietary guidance, both eating habits and nutritional conditions were reported to have improved. [11,18,32,33,41,46]. Bradbury et al. [18] reported that prosthodontic treatment combined with dietary counseling by a nutritionist resulted in a significant increase in fruit and vegetable consumption compared to the control group at six weeks following complete denture placement. Another study also reported that nutritional guidance improved nutrient intake using either conventional complete dentures or implant-supported overdentures, and the improvement was greater in patients with implants [18]. Similar results were reported by Amagai et al. in Japan [32].

Many reports suggest that the nutritional status is affected by the number of missing teeth and dental status in elderly patients requiring nursing care and patients in nursing homes [15,16,21,36,39,40,47,48,49], and our results were in agreement. In other words, for those who are unable to consider the method of food preparation and cooking for themselves, the maintenance of oral function, that is, masticatory ability, would be necessary at a minimum. There are many causes of low nutrition in the elderly, and it is important to clarify first the primary cause. Thus, the assessment of masticatory ability and diversity of food intake is warranted. If the patients report difficulty in mastication, the combination of prosthodontic treatment and nutritional guidance is considered effective.

Author Contributions

Conceptualization, T.I.; literature search, T.I, T.K. and T.G.; analysis and table preparation, T.I., T.K. and T.G.; original draft preparation, T.I.; review and editing, T.G., M.W., Y.I. and T.I.; funding acquisition, T.I. Authors have read and agreed to the published version of the manuscript.

Funding

This work received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

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