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


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. Further, 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

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

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
Table 2. Results of review papers

<table>
<thead>
<tr>
<th>No.</th>
<th>Authors</th>
<th>Year</th>
<th>Intervention/Target</th>
<th>Dietary intakes</th>
<th>Nutritional status</th>
<th>Effects</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Budtz-Jørgensen</td>
<td>2000</td>
<td>Prosthodontic</td>
<td></td>
<td></td>
<td></td>
<td>There is no evidence that the provision of prosthetic therapies can markedly improve dietary intakes.</td>
</tr>
<tr>
<td>2</td>
<td>Budtz-Jørgensen</td>
<td>2001</td>
<td>Prosthodontic</td>
<td></td>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>Ritchie</td>
<td>2002</td>
<td>Oral health</td>
<td></td>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>4</td>
<td>Sánchez-Ayala</td>
<td>2010</td>
<td>IOD vs RPD</td>
<td></td>
<td></td>
<td></td>
<td>The effect on the nutritional state in edentulous subjects treated with implant therapy is similar to the one obtained with conventional removable dentures.</td>
</tr>
<tr>
<td>5</td>
<td>Preshaw</td>
<td>2011</td>
<td>RPD</td>
<td></td>
<td></td>
<td></td>
<td>There is no evidence to support a negative impact on nutritional status.</td>
</tr>
<tr>
<td>6</td>
<td>Van Lancker</td>
<td>2012</td>
<td>Oral health in elderly</td>
<td></td>
<td></td>
<td></td>
<td>Tentative evidence indicates an independent association between oral health status and malnutrition in the elderly residing in a long-term care facility.</td>
</tr>
<tr>
<td>7</td>
<td>Tamura</td>
<td>2013</td>
<td>Oral health</td>
<td></td>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>8</td>
<td>Tada</td>
<td>2014</td>
<td>Oral health</td>
<td></td>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>9</td>
<td>Boven</td>
<td>2015</td>
<td>IOD vs CD</td>
<td></td>
<td></td>
<td></td>
<td>Chewing efficiency, maximum bite force, and satisfaction are improved. The effect on QoL is uncertain, and there is no effect on nutritional state.</td>
</tr>
</tbody>
</table>
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 [17,22,23,31,33]; 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.

References


