Relationships between oral health, dysphagia and undernutrition in hospitalised elderly patients

Philippe Poisson¹,²,³ Thibault Laffond¹, Sandra Campos⁴, Veronique Dupuis¹,⁵ and Isabelle Bourdel-Marchasson⁶,⁷,⁸

¹Department of Dentistry and Oral Health, CHU of Bordeaux, Bordeaux, France; ²Department of Oral Public Health, UFR of Odontology, Bordeaux Segalen University, Bordeaux, France; ³EA 4136 “Handicap and Nervous System”, Bordeaux Segalen University, Bordeaux, France; ⁴Dietetics Department, CHU of Bordeaux, Bordeaux, France; ⁵Department of Prosthodontics, UFR of Odontology, Bordeaux Segalen University, Bordeaux, France; ⁶Department of Gerontology, CHU of Bordeaux, Bordeaux, France; ⁷RMSB, UMR 5536 CNRS, Bordeaux, France; ⁸RMSB, UMR 5536 Bordeaux Segalen University, Bordeaux, France

Gerodontology 2014; doi:10.1111/ger.12123

Relationships between oral health, dysphagia and undernutrition in hospitalised elderly patients

Objective: The aim of this study was to describe relationships between oral status, dysphagia and malnutrition in a hospitalised older people.

Background: Undernutrition in older people is a major concern in geriatric hospital wards. Different factors can modify nutritional status like dysphagia or oral status.

Materials and methods: About 159 consecutive inpatients (108 women, 51 men) were examined. Comprehensive gerontological data at baseline and nutritional status according to BMI, MNA and serum albumin concentration, dependency according to ADL scores, dietary intake, swallowing capacities and oral status were collected. Swallowing capacities and dietary intake were reassessed 1 week after.

Results: Mean age was 85.28 (SD 5.68). Seventy-seven patients were malnourished (MNA) and 34 had dysphagia. Oral treatment was necessary in 142 patients (89.30% of all population). Candidiasis was present in 17 patients and salivary flow reduction in 50. Patients with dysphagia had the lowest dietary intake. After 1 week, patients with dysphagia were retested and dysphagia had abated in three of them. Dysphagia and undernutrition were associated ($p < 0.001$), and both were related to candidiasis ($p < 0.001$ and $p < 0.01$). Dysphagia was also related to salivary hypofunction ($p < 0.001$), loss of posterior occluding pairs (POPs; $p = 0.014$), oral self-care dependency ($p < 0.001$) and self-feeding dependency ($p < 0.001$). Salivary hypofunction was related to candidiasis ($p < 0.001$) and loss of POPs ($p < 0.05$), and candidiasis to loss of POPs ($p < 0.01$).

Conclusion: Although no causality can be demonstrated, poor oral health was strongly associated with malnutrition, emphasising the importance to develop oral care strategies and to incorporate a dental examination into comprehensive gerontological assessment.

Keywords: elderly, nutrition, saliva, Candida, tooth loss.

Accepted 20 January 2014

Introduction

Nutritional status is a major prognosis factor in older people. Adequate nutrition is associated with a reduction in adverse events related to hospital immobilisation: pressure ulcers, venous thrombosis, incontinence and functional decline¹,².

However, undernutrition is often unrecognised in the elders. In Aquitaine, a French region, about 20% of institutionalised older persons were found to be undernourished according to Mini Nutritional Assessment (MNA)³.

Masticatory function and associated pathologies may be important factors for nutrition. Several studies have shown that poor oral health is a risk factor for malnutrition⁴,⁵ and that wearing complete dentures improves nutritional status in edentulous elders⁶,⁷. Loss of teeth may induce inadequate food selection⁵,⁸ but the number of missing teeth such as fewer than six occluding
pairs of teeth\textsuperscript{9} or loss of molar teeth\textsuperscript{10} is also thought to be a risk factor for malnutrition. Moreover, the adaptation of food texture to dental status may produce a decrease in appetite by loss of eating pleasure\textsuperscript{8,11}. Finally, swallowing disorders, a frequent condition in older people, are also considered as a risk factor for malnutrition\textsuperscript{10}.

In acute care geriatric wards, undernutrition is a frequent concern and we have previously shown that dietary intake is very low in this population\textsuperscript{12}. Moreover, other studies have reported great need for dental hygiene and dental care in hospital geriatric units\textsuperscript{13,14}. However, the associations between oral health, dysphagia and undernutrition in patients hospitalised in acute care units have not yet been explored, so this paper attempts to describe them.

**Material and methods**

This study was approved by the French Scientific Society of Gerodontology. This epidemiological study included consecutive patients hospitalised over 4 months in the acute care unit of the Department of Gerontology at the Centre Hospitalier Universitaire. Patients were included after they or their surrogate had given informed oral consent. They were not included if oral examination was not possible.

Within the first 3 days of hospitalisation, an examination was performed in patients able to sit in bed or in an armchair to record oral health and swallowing abilities, while gerontological assessment data were retrieved from chart records. In the following days and 1 week after, dietary intake was recorded. A second assessment of swallowing abilities was performed after 1 week in patients with dysphagia at the first exam.

**Gerontological assessment**

Patients were described for age, sex, length of stay, in-hospital mortality, presence of diagnosis associated with oral problems and number of usual medications. Mini Mental State Examination (MMSE)\textsuperscript{15} score $<23/30$ or in-hospital delirium diagnosis indicating cognitive alteration and baseline Activities of Daily Living (ADL) score (0 to 6, 6 for full autonomy)\textsuperscript{16} were included in routine examination. Handgrip strength was measured in the dominant hand with three repetitions, and the best result was considered.

Nutritional status was described using several tools during baseline examination. Any amount of weight loss, body mass index (BMI) $<21$ kg/m$^2$ or MNA $<8/14$ was considered as undernutrition\textsuperscript{17,18}.

Routine biochemistry was extracted from records: serum albumin (g/l, normal range 38–42 g/l) and C-reactive protein (CRP, mg/l, normal $<5$ mg/l). Serum albumin $<35$ g/l also defined undernutrition\textsuperscript{17}.

Patients were considered as undernourished if any of the following variables indicated malnutrition: BMI, MNA or serum albumin.

**Dietary intake**

The texture of the food was described as regular or adapted to swallowing problems: mixed food (smooth texture, like paste, homogeneous, not lumpy, suitable for patients with dysphagia) or intermediary consistency (minced food: soft food, well cooked, in small pieces or minced so that jaw movement is sufficient to masticate it properly before swallowing. Suitable for mastication disorders).

Activities of Daily Living feeding dependency (alone, some help and total help) was isolated from the ADL scale. Dietary intake was retrieved from 3-day records and expressed in kcal/kg body weight/day and in g protein/kg body weight/day\textsuperscript{19}.

**Swallowing abilities**

Swallowing abilities were assessed using the water test (CHU de Bordeaux)\textsuperscript{20}. The patient is seated with feet on the ground. He is asked to swallow four times with increasing volumes of liquid: half a coffee spoon, full coffee spoon, full spoon and a mouthful from a glass or drunk with a straw. The first liquid is water and then water plus increasing thickening after the first sign of dysphagia using a blended thickening preparation. The resulting thickened liquids were: (i) orange juice consistency, (ii) nectar juice and (iii) jelly. The test was considered as abnormal (dysphagia) if the patient coughed during the test or during the first minute following the test, or if his voice changed.

**Oral examination**

Dental status examination was performed by a single dentist, and subjects were examined seated in an armchair or in bed. The dentist recorded the last visit to a dentist, oral self-care autonomy (alone, need help), oral hygiene by a modification of the method of Grimoud et al.\textsuperscript{21} described by Montal et al.\textsuperscript{14} – (0) Inadequate, accumulation of
plaque at the base of the teeth, (1) Adequate, no visible plaque – DMFT index (decayed, missing, filled teeth), calculus, gingival inflammation, oral candidiasis, salivary insufficiency and dental treatment need. Salivary test consisted in placing a sterile compress, weight 0.30 g, under the tongue for 5 min. Salivary insufficiency was diagnosed if weight of compress was < 0.35 g (salivary flow < 0.1 g/min).

Data management and statistics

Data capture was postponed and statistical analyses were performed with Epi Info 3.5.1 (Centers for Disease Control and Prevention, Atlanta, GA, USA) and Statistica 10 (StatSoft France, Maisons-Alfort, France). Descriptive analyses allowed description of data distribution. A comparative study was performed using the paired $t$-test, chi-square test, ANOVA and Kruskall–Wallis’ ANOVA. Then, two multivariate linear regression models were tested. First, the independent variables were selected for their potential link with the dependent variable ‘undernutrition according to MNA’ (age, gender, dysphagia, salivary hypofunction, candidiasis, posterior occluding pairs (POPs) < 7, self-feeding autonomy and autonomy for oral care). Second, the independent variables were selected for their potential link with the dependent variable ‘dysphagia’ (age, gender, undernutrition according to MNA, salivary hypofunction, candidiasis, POPs < 7, self-feeding autonomy and autonomy for oral care).

A value of $p < 0.05$ was used as an indicator of statistical significance.

Results

Among 159 included patients, 108 women and 51 men, mean age 85.28 years (SD, standard deviation 5.68), 124 subjects came from home (78%) and 35 from nursing homes (22%). The mean number of diagnoses was 7.81 (SD 2.88). The mean length of stay was 17.2 days (SD 13.1) and in-hospital mortality was 11.9%.

Gerontological assessment

Cognitive troubles were frequent in this geriatric acute care ward. The mean MMSE was 16.8 (SD 6.8). Delirium was diagnosed in 34.0%, and the resulting rate of cognitive troubles at baseline was 74.2%. Only 10 patients had full ADL autonomy. Handgrip strength was particularly low: 13.4 kg (SD 8.6) in men and 9.3 kg (SD 7.3) in women. The mean CRP was 48.4 mg/ml (SD 66.0) and was higher than 5 mg/l in all subjects.

Nutritional status

Weight loss was found in 60 (37.7%) patients but previous weight was unknown in 57 subjects, and due to the large amount of missing data, this variable was not used in the description of undernutrition. MNA was available in 144 patients, 45 (31.2%) were at risk for malnutrition and 77 (53.5%) were malnourished. A BMI below 21 kg/m² was found in 35 patients among 142 with a measured height (24.6%), and serum albumin was < 35 g/l in 67 among 133 patients (50.4%). A total of 124 (77.3%) patients were malnourished according to any of these criteria but only 21 were malnourished according to the three criteria.

Regular food was given to 96 (60.4%) patients, and 112 (70.4%) were able to eat without help. Consistently with the high rate of malnutrition estimated with these various tools, dietary intake was low. During the first week in 127 patients, mean energy intake was 16.8 kcal/kg body weight/day (SD 8.4) and mean protein intake was 0.78 g/kg body weight/day (SD 0.44). During the second week in 112 patients, mean energy intake was 18.3 kcal/kg body weight/day (SD 8.7) and mean protein intake was 1.16 g/kg body weight/day (SD 1.9) with a significant increase in protein intake (paired $t$-test, $p = 0.03$).

Swallowing abilities

Among 156 subjects with a baseline water test, 34 patients presented with swallowing problems [21.8%, 95% CI (15.6%; 29.1)]. After 1 week, 28 of 34 were retested and dysphagia was found to persist in 25 of them (Table 1). All patients who recovered a normal swallowing capacity had candidiasis at the first examination. Dysphagia was related to the presence of cognitive troubles ($p = 0.001$).

<table>
<thead>
<tr>
<th>Swallowing abilities</th>
<th>Baseline (n)</th>
<th>One week (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure water</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Thickening 1</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Thickening 2</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Thickening 3</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Inability</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Patients not reassessed (Death, transfer, discharge)</td>
<td>/</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 1 Monitoring of the 34 subjects with dysphagia at baseline.
to ADL functional dependency \( (p < 0.001) \) and particularly to self-feeding dependency \( (p < 0.001) \).

**Oral status**

Forty patients \( (25.2\%) \) were unable to remember their last visit to a dentist, and 93 \( (58.5\%) \) declared no visit during the previous 2 years. Autonomy for oral care was found in 102 patients \( (64.1\%) \). Dental examination found dental plaque in 92 patients \( (57.9\%) \); mean DMFT index was 20.2 (SD 7.4); 142 patients \( (89.3\%) \) had need of dental treatment: scaling \( 51.6\% \), extraction \( 34.0\% \), conservation \( 50.3\% \) and prosthesis \( 69.2\% \). Oral candidiasis was found in 17 patients \( (10.70\%) \) and low flow salivary in 50 \( (31.4\%) \).

**Relationships between nutritional variables, dysphagia and oral status**

Table 2 shows the relationships between the cross-sectional variables of the study. Dietary intake appeared higher in subjects with the lowest BMI. When expressed in total intake and not related to body weight, the apparent increase in dietary intake disappeared. Subjects with dysphagia had the lowest dietary intake \( (p = 0.001 \text{ and } p = 0.026) \) and were more likely to be classified as undernourished according to MNA \( (p = 0.003) \) and serum albumin \( (p = 0.016) \). Oral candidiasis and low salivary flow were strongly related \( (\text{ANOVA } p < 0.0001) \), and dysphagia was related to both \( (p < 0.001 \text{ for both}) \). Oral self-care dependency and having fewer than 7 POPs were also associated with dysphagia \( (\text{respectively } p < 0.001 \text{ and } p = 0.014) \). Moreover, candidiasis was related to undernutrition estimated by MNA \( (p < 0.01) \).

**Multivariate analysis**

Autonomy for oral care was the only one variable independently associated with undernutrition according to the MNA \( (p = 0.004; \text{Table 3}) \).

Oral candidiasis was independently associated with dysphagia \( (p < 0.001; \text{Table 3}) \).

**Discussion**

This older people in an acute care unit were very sick with high inflammatory status. The malnutrition rate differed according to the tool used but in combination, the resulting rate of undernutrition was very high. The low level of dietary intake, reaching less than half of needs\(^{22}\), confirms the huge nutritional problem in such persons. Paradoxically, those with the lowest BMI had the highest energy intake, as found elsewhere\(^{23}\). Owing to high CRP concentrations, hypercatabolism is likely to play a major role in these patients in association with low dietary intake. Poor oral health is related to the gerontological assessment: items such as number of pathologies, cognitive troubles and functional dependency.

Reduced physical fitness\(^{10}\) or dependency and weak masticatory ability\(^{9}\) have been described as risk factors for malnutrition. We found a relationship between self-feeding dependency or oral self-care dependency and dysphagia. Older people with self-feeding dependency need efficient help by caregivers and dietary adaptation if dysphagia is diagnosed. Indeed, sufficient time is necessary to allow proper daily energy intake. Moreover, screening for dysphagia should be a routine procedure for caregivers by testing swallowing ability\(^{24}\).

Poor oral health plays a role in the frequency of undernutrition, mainly due to a reduction in salivary flow and candidiasis, which are both related to hypercatabolism. Patients with chronic dysphagia may select food that they know they can swallow, potentially leading to nutrient deficit and the onset or worsening of malnutrition\(^{1,10,25}\). Furthermore, their global intake is lower, as observed here owing to their slowness in ingesting food and their need for help during meals. The rate of dysphagia was high in this study but may not reflect the exact prevalence in acute care units owing to sample selection.

In our study, age was not significantly associated with undernutrition according to MNA and dysphagia-dependent variables. It might also be associated with sample selection as the population studied was hospitalised people 75 years old and over.

Oral candidiasis, which interfered with dysphagia in our study, may induce difficulties in chewing and swallowing in older people, reducing also dietary intake. Like other authors, we found a strong relationship between low salivary flow and dysphagia\(^{26–28}\). Low salivary flow first induces a defect in lubrication and the cohesion of the bolus\(^{27,28}\) and then a dry feeling in the mouth, which makes chewing unpleasant. The rubbing of dentures against the oral mucosa exacerbates this sensation\(^{27,28}\). Dysphagia associated with salivary hypofunction can cause a loss of appetite and a restricted choice of dietary intake\(^{29}\). A decrease in salivary flow can be the result of medication (antidepressants, tranquilizers and antihistamines), chronic oral ventilation, a pathology
Table 2 Distribution of nutritional variables, dysphagia and oral exam variables.

<table>
<thead>
<tr>
<th></th>
<th>Total population (N = 159)</th>
<th>MNA 0-7</th>
<th>BMI &lt; 21 kg/m²</th>
<th>Serum albumin &lt; 35 g/l</th>
<th>Dysphagia</th>
<th>Dental plaque</th>
<th>Low salivary flow</th>
<th>Candidiasis</th>
<th>Posterior occluding pairs &lt; 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>159</td>
<td>77</td>
<td>38</td>
<td>67</td>
<td>34</td>
<td>92</td>
<td>50</td>
<td>17</td>
<td>82</td>
</tr>
<tr>
<td>Energy intake kcal/kg body weight/day mean (SD)</td>
<td>15.9 (9.0) **</td>
<td>20.9 (9.8) ***</td>
<td>16.7 (8.4)</td>
<td>11.7 (6.5) ***</td>
<td>17.8 (8.9)</td>
<td>15.0 (8.5)</td>
<td>13.0 (8.0)</td>
<td>16.5 (9.2)</td>
<td></td>
</tr>
<tr>
<td>Protein intake g/kg body weight/day mean (SD)</td>
<td>0.77 (0.48) *</td>
<td>0.95 (0.56) **</td>
<td>0.37 (0.80)</td>
<td>0.60 (0.31) *</td>
<td>0.82 (0.47)</td>
<td>0.74 (0.38)</td>
<td>0.67 (0.39)</td>
<td>0.73 (0.40)</td>
<td></td>
</tr>
</tbody>
</table>

*<0.05, **<0.01, ***<0.001.

MNA, Mini Nutritional Assessment; BMI, body mass index.
Table 3 Outcome of multivariate regression with undernutrition according to MNA and dysphagia as dependent variable.

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>MNA 0-7</th>
<th>Dysphagia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td>p-Value</td>
</tr>
<tr>
<td>Age</td>
<td>0.006</td>
<td>0.448</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.016</td>
<td>0.869</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>-0.003</td>
<td>0.983</td>
</tr>
<tr>
<td>Salivary hypofunction</td>
<td>0.148</td>
<td>0.425</td>
</tr>
<tr>
<td>Candidiasis</td>
<td>-0.014</td>
<td>0.876</td>
</tr>
<tr>
<td>Posterior occluding pairs</td>
<td>-0.129</td>
<td>0.311</td>
</tr>
<tr>
<td>MNA 0-7</td>
<td>-0.375</td>
<td>0.004</td>
</tr>
</tbody>
</table>

MNA, Mini Nutritional Assessment.

(diabetes, Sjögren’s syndrome and renal insufficiency) or be due to poor masticatory function. For several authors, poor dental status due to loss of teeth decreases the ability to chew, which is step preceding swallowing. In the elders who risk malnutrition, the number of premolar–molar occluding pairs appears to be a good index of masticatory ability. In our study, patients with fewer than seven POPs had a higher risk of dysphagia. During chewing, the absence of posterior teeth slows down the formation of a homogeneous bolus and swallowing becomes more difficult owing to the formation of a less cohesive bolus. In frail older people, this defective bolus disturbs swallowing with the risk of food aspiration. Moreover, the association of the absence of posterior teeth and a decrease in tongue strength in older people can induce a defect in the retention of the bolus in the posterior part of the mouth, and food fragments may fall early onto the pharynx. Dion et al. reported that loss of two molars induced a 1.15-fold greater risk of malnutrition. An explanation may be that poor masticatory ability modifies dietary choice and decreases eating pleasure. Our study did not find any direct relationship between absence of posterior teeth and nutritional status of dependent older people, but there was a relationship between the presence of fewer than seven POPs and candidiasis or low salivary flow. We propose two successive events to explain an indirect relationship with dysphagia: first, loss of POPs is a risk factor for dysphagia, which is also risk factor for malnutrition; second, loss of POPs decreases chewing efficacy, which may induce atrophy of the salivary gland and decrease salivary flow, which is a risk factor for candidiasis or dysphagia. The latter are both risk factors for undernutrition.

In our study, 57.9% of patients had poor oral hygiene and 89.3% required oral treatment, figures in accordance with previous studies concerning institutionalised geriatric patients. Several authors have reported the efficacy of geriatric oral hygiene programmes in preventing oral disease. Moreover, oral hygiene improves quality of life and reduces frequency of pneumonia and death due to pneumonia. For

Figure 1 Relationship between oral health, dysphagia and undernutrition. MNA, Mini Nutritional Assessment.
the latter, two explanations were proposed: oral hygiene may improve cough reflex sensitivity\textsuperscript{37}; and oral hygiene removes dental plaque, which is a reservoir of potential respiratory pathogens\textsuperscript{38,39}. However, several factors may affect the efficacy of a caregiver’s intervention in oral hygiene: lack of knowledge, need for a simulating education session\textsuperscript{40} and insufficient time\textsuperscript{36,40}. Concerning oral care, dental treatment is known to have a positive effect on quality of life\textsuperscript{41}. De Marchi et al.\textsuperscript{6} and N’Gom et al.\textsuperscript{8} insisted on the positive effect of preserving natural teeth in the elders to improve nutritional status and dietary intake. Indeed, a link has been found between mean nutrient intake and number of POPs of natural teeth in older people\textsuperscript{42}.

**Conclusions**

Despite the limitations of this study, the findings revealed a relationship between dysphagia and undernutrition status according to MNA, and both were related to candidiasis. Dysphagia was also related to salivary hypofunction, loss of POPs, oral self-care dependency and self-feeding dependency. Salivary hypofunction was related to candidiasis and loss of POPs, while candidiasis to loss of POPs (Fig. 1). Therefore, oral health appears important in nutritional care. Although no causality can be demonstrated, these results emphasise the importance of developing an oral hygiene plan within the framework of comprehensive gerodontological assessment, as recommended in subjects with diabetes\textsuperscript{43}. Moreover, future studies are necessary to evaluate the effects of dental treatment on dietary intake.

**Acknowledgements**

The authors thank Ray Cooke for linguistic assistance.

**References**


42. de Andrade FB, de Franca Caldas A Jr, Kitoko PM. Relationship between oral health, nutrient intake and nutritional status in a sample of Brazilian elderly people. *Gerodontology* 2009; 26: 40–5.


Correspondence to:
Dr Philippe Poisson,
UFR d’Odontologie, Université Bordeaux Segalen, 16 cours de la Marne, 33082 Bordeaux Cedex, France.
Tel.: +33 5 57 57 30 04
Fax: +33 5 57 57 30 20
E-mail: philippe.poisson @u-bordeaux2.fr