

FOOD INTAKE SELECTION INFLUENCED BY OPPOSING FUNCTIONAL NATURAL TEETH OR REMOVABLE DENTURE: OBSERVATIONAL STUDY

ABSTRACT

AIM: The purpose of this study was to investigate the relationship between types of dentition in occlusion and the perceived ability to eat a range of common foods in elderly. **MATERIAL AND METHODS:** We included 363 individuals (117 men, 246 women; mean age = 73.4 ± 5.8 years) Self-reported information on questionnaires were linked to oral examination to establish types of dentition in occlusion assessing their influence on the needs to alter the food selection and on the difficulty to chew key foods. **RESULTS:** The individuals were classified as having their occlusion performed by completed removable prostheses (D/D) (51.2%), mixed dentition (D/N-N/D) (32.8%) or with natural teeth (N/N) (16%). Individuals with natural teeth N/N or mixed dentition (N/D-D/N) had less necessity to change their food intake, relative to individuals with their occlusion performed by complete removal denture (D/D) ($p < 0.05$). Most of the individuals that had to modify their food intake avoided hard-to-chew food ($p < 0.05$). **CONCLUSION:** The reduced masticatory ability may lead to changes in dietary selection with risk of an impaired nutritional status especially in elderly complete denture wearers.

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INTRODUCTION

Proper nutrition of the elderly is essential for general health. Also, the maintenance or reestablishment of oral health and oral comfort are essential for an adequate nutritional intake.¹ Masticatory function decreases with increasing tooth loss,² consequently many elderly face significant challenges due to their oral status, as they often have either only a few teeth or no natural teeth at all.^{3,4} Denture wearers are particularly affected in their masticatory process as they generally need more chewing cycles, have a longer duration of mastication sequence and increased Electromyography (EMG) activity.^{5,6}

The impaired masticatory function often imply a change in the selection of food, by choosing a diet that they can chew in comfort.⁷ Such diet is often low in fiber and nutrient density⁸ and may lead to malnutrition, which in turn increases the risk of physical disability and mortality in the long run.^{9,10}

The relationship between oral health status and lower intake of important nutrients such fruits and vegetables, fiber, and carotene, might also account for the association between edentulism and inadequate percentage body fat.^{11,12} Specifically, the dietary adequacy due to impairments in masticatory function in patients wearing dental prostheses may be the reason why edentulous persons are more prone to be underweight.¹³

In dentate, the loss of posterior teeth can also reduce chewing performance.⁽¹⁴⁾ Such impairment may be reduced by replacing teeth lost with partial dentures, or dental implants in one or both dental arches.^{15,16} However, in contrast to the occlusal function in patients with fairly complete natural dentition, when occlusal function is maintained by prostheses, the masticatory efficiency is still inferior.^{17,18}

A previous study has shown that the denture type and denture retention influenced the food selection and consequently on the individual's nutritional state.¹⁹ Furthermore, another study reported that the association between perceived chewing ability and oral health-related quality of life (OHRQoL) was substantially more influenced by denture status than by the number of natural teeth.²⁰

Hence, masticatory performance appears to be influenced by the number of teeth. However, even though the number of teeth and use of prostheses types is often being used as an estimate of the level of masticatory performance and the difficulty in eating hard foods,²¹ these variables do not account for the difference between types of dentition occlusion and its importance for proper function.^{22,23}

Thus, it is reasonable to assume that subjective ability to eat a range of foods can be predicted by the types of dentition and their occlusion. The data from the present study may contribute to understand if there are any

associations between types of dentition in occlusion, mastication ability and the diet selection in elderly persons. Therefore, the aim of this study was to investigate the relationship between types of dentition in occlusion and perceived ability to eat a range of common foods in elderly. We hypothesized that elderly who have opposing natural teeth and/or natural teeth opposing prosthetic teeth changed less their diet intake due to difficulties to chew than individuals with removable dentures.

MATERIAL AND METHODS

This cross-sectional study was part of a larger cohort study of older persons in the city of Carlos Barbosa in southern of Brazil, who has been conducted since 2004. People aged 60 and older who were living independently were invited to take part in the study at baseline in 2004. Details regarding study design and participant eligibility requirements have been reported previously.¹³ Previous studies conducted in this cohort with data from a baseline in 2004 and first follow-up in 2008, were performed, focused on the number of teeth and use of dental prostheses, as well the nutritional status, diet and anthropometric measurements.¹³ In 2012 was done the second follow-up and the final sample consisted of 389 individuals, physically and mentally able to complete an interviewer-administered survey.

The present study was approved by the Committee of Ethics in Research of the Faculty of Dentistry of the State University of Campinas (register number 017/2011). All participants provided written informed consent prior to participation.

1 MEASUREMENTS:

All participants completed an interviewer-administered structured questionnaire that included questions about their social and demographic background, behaviors and medical and dental health. The masticatory self-report satisfaction and the time since the first prosthesis were also assessed.

1.1 Dental examination:

Participants underwent a dental examination by a trained and calibrated examiner, who recorded the number of natural teeth, removable dentures and fixed partial dentures (FPD), following the World Health Organization (WHO) criteria.²⁴ All types of prostheses and the natural teeth distribution were recorded. The functional types of dentition were established by dental examination of each antagonist occlusion and established if a functional contact existed between two natural teeth or between natural teeth and dentures.²⁵ Removable dentures not worn at the examination and roots without clinical crowns were not recorded. Types of

dentition were subdivided in three categories (Figure 1).

1.2 Needs to change the food selection and ability to eat key foods:

A question about the need to change their food selection due to problems with teeth or dentures was used to determine whether dental status may influence in food preferences.^{8,26}

To assess the foods choice, all the patients were asked to rate the amount of difficulty they had eating certain key foods representing a range of food types as raw carrot, apple, peanut, steak and toast bread and easy-to-chew foods as lettuce.² The answers options were choose by the participant as never, rarely, frequently or always, after, these options were dichotomized (yes or no) for both parameters.

2 STATISTICAL ANALYSIS:

Computerized data were converted for analysis by the statistical program SPSS 20.0 (Statistical Package for the Social Sciences). Descriptive analyses were done to establish the frequencies of all data and key socio-demographic, oral and general health information as well dietary variables.

The analyses were performed in two steps. First, Poisson bivariate regression analyses were conducted and included comparisons between key socio-demographic,

oral and general health information, dental data and dietary variables. The results from these bivariate analyses were analyzed using a Poisson multivariate regression model to test the main effects of types of dentition on the need to alter the food selection and the self-reported ability to eat a range of hard and easy-to-chew-food, in all cases controlling for the potential confounding effects of age, sex, income, and area of residence, length of time of the first denture and masticatory satisfaction, irrespective of their statistical significance.

Interaction between the need to change the food selection and the ability to eat a range of foods was tested for all models. If the interaction was not significant, the interaction term was dropped from the final model. The comparison of the unadjusted and the adjusted regression coefficients provided no evidence of significant effect of collinearity. The level of significance was set at $p < 0.05$.

RESULTS

1 SAMPLE CHARACTERISTICS:

From the total sample of 389 individuals that accepted to participate of the study, 26 individuals (6.6%) after the dental examination were classified as having nonfunctional teeth or opposing prosthetic replacement and were excluded. Hence the final eligible sample consisted of 363 individuals that had a mean age (\pm SE) of 73.4 \pm 5.8 years. The sample included 246 women

(67.8%) the majority of the total sample lived in the urban area (56.5%) and fifty-six percent of the individuals had an income less than two Brazilian minimum wages (Table 1).

2 TYPES OF FUNCTIONAL DENTITION:

Most of the participants had occlusion performed by D/D (51.2%), followed by 32.8% of individuals with mixed types of functional dentition (N/D-D/N). Patients with natural teeth (N/N) performing their occlusion comprised 16% of the total sample (Table 1).

3 FOOD SELECTION:

Subjects who were classified as having their occlusion relation performed by complete removal dentures (P/P) had significantly more food modification reported than those patients with natural teeth (N/N) and mixed types of functional dentition (N/D-D/N) (Table 2), ($p < 0.05$).

4 ABILITY TO CHEW SPECIFICS FOODS:

The patients also reported the ability to chew different food categories such as raw carrot, apple, peanut, steak, toast bread and lettuce (Table 3). We found that individuals who had their occlusion performed mixed types of functional dentition (N/D-D/N) or natural teeth (N/N) reported a greater ability to chew on hard foods such as raw carrots, apple and toast bread ($p < 0.05$) than those who had removable completed dentures in both

arches (D/D). Similar results were found in respect to the ability to eat peanuts, with a significant difference of less self-reported ability between those patients who had complete removable dentures (D/D), relative to those who had natural teeth N/N ($p < 0.05$) as well compared to those with mixed types of functional dentition (N/D-D/N) ($p < 0.001$). For the ability to eat steak, individuals classified as having mixed types of dentition showed greater ability compared to P/P category.

Difficult to chew lettuce did not differ between the types of dentition N/N and D/D ($p > 0.05$).

The patients also answered if they were satisfied with their masticatory function, and the masticatory ability was correlated both positively as negatively with need to alter their food selection and ability to eat key foods. For example, the masticatory satisfaction was positive and significantly higher correlated for those patients who had ability to eat almost all the key foods recorded than those that need to alter and avoid, for example, raw carrot and apple ($p < 0.05$). Similarly, most of the individuals that showed no masticatory satisfaction also reported to feel the need to change their food selection showed avoidance to these specifics food recorded on the present analyze ($p < 0.05$).

Table 1. Percentage of individuals, social-demographics characteristics, masticatory satisfaction, types of dentition, length of time of the first denture and who reported they could alter their food selection.

Characteristic	N (%)	Needs to alter food selection
Sex, n (%)		
Male	117 (32.2%)	28 (7.7%)
Female	246 (67.8%)	92 (25.3%)
Zone, n (%)		
Urban	205 (56.5%)	61 (16.8%)
Rural	158 (43.5%)	59 (16.3%)
Age, n (%)		
≤ 72 years old	185 (51.0%)	55 (15.2%)
> 72 years old	178 (49.0%)	65 (17.9%)
Income, n (%)		
≥ 1245,00 reais	157 (43.4%)	45 (12.4%)
≤ 1244,00 reais	205 (56.6%)	75 (20.7%)
Masticatory satisfaction, n (%)		
Satisfied	311 (85.7%)	95 (26.2%)
Dissatisfied	52 (14.3%)	25 (6.9%)
Types of dentition, n (%)		
N/N	58 (16.0%)	15 (4.1%)
N/D - D/N	119 (32.8%)	26 (7.2%)
D/D	186 (51.2%)	79 (21.8%)
Length of time of the first denture, n (%)		
< 25 years	91 (25.1%)	35 (9.6%)
≥ 25 years	272 (74.9%)	85 (23.4%)
Total	363 (100%)	120 (33.1%)

N/N: natural upper teeth/natural lower teeth; N/D: natural upper teeth/mandibular removable partial or complete denture; D/N: Maxillary removable partial or complete denture/natural lower teeth; D/D: maxillary complete denture occluding with mandibular complete denture.

Table 2. Results of Poisson Regression for Associations Between Associations Between Needs to Alter Their Food Selection and Types of Functional Dentition.

	Needs to alter foods selection	
	Unadjusted PR (CI)	Adjusted PR (CI)
N/N	0.60 (0.38 - 0.97) ^a	0.67 (0.41 - 1.09)
N/D-D/N	0.51 (0.35 - 0.75) ^a	0.52 (0.36 - 0.77) ^a
D/D	1	1

Adjusted PR: Prevalence ratio adjusted for the variables included in the Table 1. CI: Confidence intervals; 1: Reference category; N/N: natural upper teeth/natural lower teeth; N/D: natural upper teeth/mandibular removable partial or complete denture; D/N: Maxillary removable partial or complete denture/natural lower teeth; D/D: maxillary complete denture occluding with mandibular complete denture. Overall significant level is indicated, though some individual PR may include 1.0. ^ap<0.05; ^bp<0.001

DISCUSSION

Good nutrients and having an adequate dietary intake usually require healthy natural teeth and/or well-adapted dentures. Hence,

this poses significant challenges for older individuals who have reduced chewing ability and this reduced consumption of an appropriate and balanced diet.³ Most studies

that investigated the influence of oral status on food selection used number of teeth or edentulous patients with-out dentures to explain these association.^{21,22} In the present study, we split the sample by types of dentition on occlusion. This made it possible to investigate the influence of different possibility of occlusion performed by three types of functional dentition on the ability self-related to eat foods. The strategy usually used to access chewing ability taking into account only

the number of teeth may be a less accurate measure of masticatory potential. For instance, in situations where the patient may have a considerable number of teeth but none of which have opposing occlusal contacts, providing that a decrease of the individual's ability to chew and subsequently influences foods choice, the measures of types of dentition in occlusion and/or functional units maybe a more preferred approach.²⁵

Table 3. Results of Poisson Regression for Associations Between Ability to Chew Specifics Foods and Types of dentition.

	RAW CARROT	APPLE	PEANUT	STEAK	TOAST BREAD	LETTUCE
	PR (CI)	PR (CI)	PR (CI)	PR (CI)	PR (CI)	PR (CI)
N/N	1,91 (1.37 - 2.64) ^a	1.58 (1.23 - 2.03) ^b	1.34 (1.09 - 1.65) ^a	1.13 (0.91 - 1.32)	1.32 (1.08 - 1.60) ^a	1.04 (0.97 - 1.11)
N/D-D/N	1.61 (1.21 - 2.13) ^b	1.27 (1.03 - 1.57) ^a	1.35 (1.14 - 1.60) ^b	1.15 (1.02 - 1.29) ^a	1.23 (1.05 - 1.43) ^a	1.04 (1.00 - 1.09) ^a
D/D	1	1	1	1	1	1

PR: Prevalence ratio adjusted for the variables included in the Table 1. CI: Confidence intervals: 1: Reference category; N/N: natural upper teeth/natural lower teeth; N/D: natural upper teeth/mandibular removable partial or complete denture; D/N: Maxillary removable partial or complete denture/natural lower teeth; D/D: maxillary complete denture occluding with mandibular complete denture. Overall significant level is indicated, though some individual PR may include 1.0. ^ap<0.05; ^bp<0.001.

The results showed that the individuals classified having mixed types of functional dentition (N/D-D/N) that have at least one removal dentures, but with natural teeth oppose occlusion had less necessity to modify their food selection ($p<0.05$), relative to patients those who have complete removable denture in both maxilla (D/D). These results are in line with studies focusing on this type of rehabilitation that showed the decrease of 50

to 85% of masticatory efficiency relative to dentate individuals.^{17,18}

In addition, it is reasonable to assume that the replacement of any removable dental prosthesis linked with either natural teeth stabilization or oppose occlusion has resulted in better subjective chew outcomes and food satisfaction, similarly to the patients that had most natural teeth (N/N).¹⁶ The improvement of the denture retention and/or efficiency due

to the number and distribution of remaining natural teeth²⁵ might discourage them from avoiding chew types of food such as apple and peanuts which need a good chew to break down.¹⁵

There is growing concern about diet and dentition, owing to the significant role of nutrition intake in the etiology of common systemic diseases. Several studies have identified potential mechanisms amounting for these associations.^{1,6,7,12} Conversely, some data considered the oral status as a minor influence in food selection or refuse the association with respect to the number of teeth and inadequate nutrient intake.^{22,23}

The present analysis did not evaluate the masticatory function, the nutritional status, diet and anthropometric measurements to compare with the oral status, however, the results confirm that even after confounding factors are controlled for, the category of type of dentition classified as D/D influences the ability of individuals to modify their diet avoiding hard-to-chew food ($p < 0.05$).²

Thus, elderly might tend to consume lower levels of nutrient sources of protein and vitamins, which might lead to impaired general health status.¹¹⁻¹³ In addition, according to the results there is a prediction that mastication in denture wearers (D/D) tend to display an endeavor to suit to their masticatory impairment, such as avoid to eat hard-to-chew food to keep chewing with comfort.

CONCLUSION

The results of this study show that individuals who have natural teeth N/N or mixed types of functional dentition (N/D-D/N) have had less necessity to change their food intake due to the oral status, relative to individuals with their occlusion performed by complete removal denture. Most of the individuals that had to modify their food intake avoided hard-to-chew food. Thus, since mastication ability is an important component of having a high quality of daily life and its deficiency may cause food modification and avoidance, future studies should include the assessment of the types of dentition responsible for occlusion performance as a variable in the prediction of chewing impairments.

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REFERENCES

1. Budtz-Jørgensen E CJ, Rapin CH. Nutrition and oral health. *Best Practice & Research Clinical Gastroenterology* 2001;15(6):885–96.
2. Sheiham A SJ. Does the condition of the mouth and teeth affect the ability to eat certain foods, nutrient and dietary intake and nutritional status amongst older people?. *Public Health Nutr* 2001 (4): 797–803.

3. Wayler AH aCH. Impact of complete dentures and impaired natural dentition on masticatory performance and food choice in healthy aging men. *The Journal of Prosthetic Dentistry* 1983;49(3):427-33.
4. Hugo FN HJ, Sousa MLR, Silva DD, Pucca GA Jr Correlate of partial tooth loss and edentulism in Brazilian elderly. *Community Dent Oral Epidemiol* 2007(35):224-32.
5. Veyrone J-L ML. Complete denture wearers: EMG of mastication and texture perception whilst eating meat. *Eur J Oral Sci* 2000(108):83-92.
6. Mishellany-Dutour A RJ, Peyron M, Rimek F and Woda A Is the goal of mastication reached in young dentates, aged dentates and aged denture wearers? *British Journal of Nutrition* 2008(99):121-8.
7. Walls A SJ, Sheiham S, Marcenes W, Moynihan P Oral health and nutrition in older people. *Journal of Public Health Dentistry* 2000;60(4):304-7.
8. WH YAaE. Dietary selections of persons with natural and artificial teeth. *J Pros Den* 1964;14(4):695-7.
9. Shimazakil Y SI, Saitol T, Yamashital Y, Kogal T, Miyazaki H, Takehara T Influence of Dentition Status on Physical Disability, Mental Impairment, and Mortality in Institutionalized Elderly People. *J Dent Res* 2001;80(I):340-5.
10. Murray Global Burden of Oral Conditions in 1990-2010: A Systematic Analysis [database on the Internet]. [cited].
11. Ranta K TR, Paunio I et al. . Dental status and intake of food items among an adult Finnish population. *Gerodontology* 1988(4):32-5.
12. Emami E FdSR, Kabawat M, Feine J The Impact of Edentulism on Oral and General Health. *International J Dent* 2013;2013:1-7.
13. De Marchi RJ HF, Hilgert JB, Padilha DM Association between number of teeth, edentulism and use of dentures with percentage body fat in south Brazilian community-dwelling older people. *Gerodontology* 2012(29):e69-e76.
14. Van der Bilt A OL, Bosman F, Oosterhaven SP The effect of missing postcanine teeth on chewing performance in man. *Arch Oral Biol* 1993(38):423-9.
15. Budtz-Jørgensen JPC, P. Mojon Successful aging—the case for prosthetic therapy. *Journal of Public Health Dentistry* 2000;60(4):308-12.
16. Liedberg B NP, Öwall B, Stoltze K Masticatory and nutritional aspects on fixed and removable partial dentures. *Clin Oral Invest* 2004(8):11-7.
17. Ge C. Masticatory efficiency: the effect of age, the loss of teeth and prosthetic rehabilitation. *Int Dent J* 1984(34):93-7.
18. Baum B BU. Aging and oral motor function: evidence for altered performance among older persons. *J Dent Res* 1983(62):2-6.
19. Morais JA HG, Pawliuk J, Lund JP, Feine JS The effect of mandibular two-implant overdentures on nutrition in elderly edentulous individuals. *J Dent Res* 2003(82):53-8.
20. Inukai M JM, Igarashi Y, Baba K Association between perceived chewing ability and oral health-related quality of life in partially dentate patients. *Health and Quality of Life Outcomes* 2010(8):118.
21. Ervin RB BA. The Effect of Functional Dentition on Healthy Eating Index Scores and Nutrient Intakes in a Nationally Representative Sample of Older Adults. *Journal of Public Health Dentistry* 2009;69(4):207-16.
22. Osterberg T TK, Rothenberg E, Carlsson GE, Steen B Masticatory ability in 80-year-old subjects and its

relation to intake of energy, nutrients and food items. Gerodontology 2002(19):95-101.

23. Liedberg B SK, Norlen P, Owall B . Gerodontology . 'Inadequate' dietary habits and mastication in elderly men. 2007(24):41-6.

24. Organization WH. Oral health surveys: basic methods. In: Organization WH, editor. Geneva 1997.

25. Hildebrandt GH DI, Schork MA, Loesche WJ Functional units, chewing, swallowing, and food avoidance among the elderly. The Journal of Prosthetic Dentistry 1997;77(6):588-95.

26. Quandt SA CH, Bell RA, Savoca MR, Anderson AM, Leng X, Kohrman T, Gilbert GH, Arcury TA. Food Avoidance and Food Modification Practices of Older Rural Adults: Association With Oral Health Status and Implications for Service Provision. The Gerontologist 2010;50(1):100-11.