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ORIGINAL ARTICLE

The Association Between Masticatory Performance, Oral Health Status, and Dental Prostheses in Adults at a Dental Hospital in Jakarta

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ABSTRACT

Masticatory performance has been studied extensively in the past few decades. Age, gender, the number of teeth in occlusion, occlusal contact area, salivary flow, and neurophysiological deficits influence the masticatory process. The replacement of missing teeth with dental prostheses, whether fixed or removable, is often used to achieve an acceptable level of masticatory performance. **Objective:** The present study aimed to analyze the association between masticatory performance and age, gender, and oral health status based on the decayed, missing, and filled teeth (DMF-T) score, denture use, and denture condition in an adult population. **Methods:** This study included a total of 152 individuals (60 males and 92 females) aged 17 years or older (mean \pm standard deviation: 33.4 \pm 13.1 years). Masticatory performance was evaluated using color-changeable chewing gum. The chi-squared test was used to assess the association between masticatory performance and age, gender, DMF-T score, dental prosthesis use, and prosthesis condition. **Results:** Age ($p=0.001$), missing teeth ($p=0.001$), and prosthesis use ($p=0.011$) had significant relationships with masticatory performance. However, the correlations between masticatory performance and gender, tooth decay, fillings, and prosthesis condition were not statistically significant ($p>0.05$). **Conclusion:** Age, missing teeth, and prostheses are strongly associated with masticatory performance.

Key words: chewing gum, dental prosthesis, mastication

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INTRODUCTION

Mastication is a complex process characterized by the breakdown of food into smaller particles to increase their surface area and to promote enzymatic function and food digestion. Masticatory performance has been widely studied in the past decade. The available literature shows that masticatory performance is influenced by several factors, including age, sex, number of intact teeth, occlusion, occlusal contact area, tooth loss, posterior tooth restoration, salivary flow rate, and decreased oral motor function.¹ Masticatory performance in patients with compromised dental health is significantly reduced relative to patients with healthy teeth.² One compromising condition that affects the occlusal contact area is dental caries. Caries can cause pain and local damage to hard tissues and may impede the process of physically breaking down food. Thus, caries has a significant impact on masticatory

performance.³ Additionally, sex has a significant effect on individual masticatory performance, as men have higher chewing power than women.⁴ Masticatory performance is also believed to be influenced by age. However, aging does not directly cause reductions in masticatory performance, especially among individuals who still have occlusion contact in the posterior teeth.⁵

Dental rehabilitation aims to restore oral function, especially masticatory performance. Quality of life improves when mastication function is restored through dental rehabilitation.⁶ Prosthodontic rehabilitation with fixed or removable dentures serves to improve the mastication ability of individuals with partial or complete tooth loss. The masticatory performance of denture wearers largely depends on the type of denture used as well as the number and distribution of remaining teeth. Studies have reported that denture wearers have masticatory performance and chewing

pressures of one-sixth to one-half that of individuals with healthy, intact teeth.⁷ Several factors can affect the mastication ability of denture wearers, and these can generally be separated into two categories: those associated with the design, retention, and stability of dentures and those associated with the morphology, physiology, and psychology of denture wearers.⁸

Mastication function can be objectively examined through clinical tests or subjectively through questionnaires that assess patients' perceptions of their ability to chew food. Color-changeable chewing gum (Masticatory Performance Evaluating Gum XYLITOL®; Lotte Co., Ltd., Saitama, Japan) is one of the objective tools for measuring masticatory performance. When the chewing gum is mixed with saliva as mastication proceeds, the pH inside the chewing gum increases because of the excretion of the citric acid into the saliva and, at the same time, elution of the yellow and blue pigments changes the color of the chewing gum from yellowish-green to red. This method can not only be applied in laboratories and specialized institutions, but also across larger study populations because it is simple, inexpensive, and easy to use, and it only takes a few minutes to obtain results in terms of the change in color of the chewing gum. This approach of measuring color changes using this color scale is a valid and reliable method for measuring mastication ability.^{9,10}

Masticatory performance tests have not been widely carried out in Indonesia. A previous study in Indonesia used a questionnaire to measure mastication subjectively, and this was only carried out on an elderly population of denture users.¹¹ Meanwhile, objective assessments using color-changeable chewing gum for various age groups, specific analyses of the relationship between masticatory performance and denture type, and comparisons between denture users and individuals with intact teeth have not been widely reported. Hence, this study aimed to analyze the relationship between masticatory performance and age, gender, oral health status based on the DMF-T score, dental prosthesis use, and prosthesis condition in an adult population.

METHODS

Participants

This was a cross-sectional study. The subjects were patients at the Dental Hospital Faculty of Dentistry, Universitas Indonesia. This study was approved by the Ethical Committee of the Faculty of Dentistry Universitas Indonesia (No.29/Ethical Approval/FKGUI/VIII/2015). All participants signed an informed consent document before the start of data collection. The inclusion criteria were an age of 17 years or older, good general health, and the ability to communicate adequately.

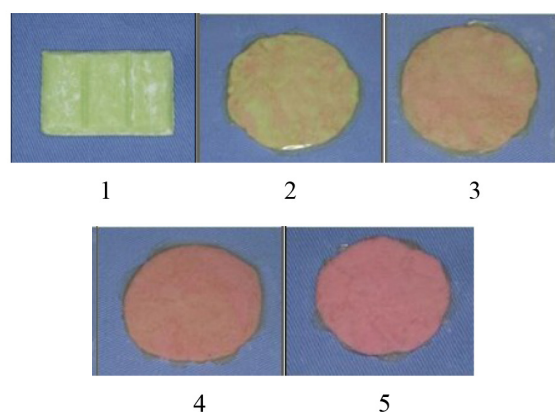


Figure 1. A depiction of the color scale used to evaluate masticatory performance with color-changeable chewing gum

Measurement

The condition of the subjects' teeth was recorded using the DMF-T index with the D, M, and F components scored separately. In addition, for subjects who used dentures, examination of the condition of the denture regarding retention, stabilization, denture irritation, occlusal wear of artificial teeth, and proximal contact point were observed. Color-changeable chewing gum (Masticatory Performance Evaluating Gum XYLITOL®; Lotte Co., Ltd., Saitama, Japan) was used to evaluate masticatory performance. Patients were instructed to chew the gum for 1 minute.¹² The change in the color of the gum was measured using a five-point color scale (1 = very poor, 2 = poor, 3 = adequate, 4 = good, 5 = very good) by one investigator (Figure. 1).

Statistical analysis

All data collected were processed using the Statistical Package for the Social Sciences version 20 (IBM Corp., Armonk, NY, USA). Univariate data analysis was performed to obtain an overview of the sample population. The chi-squared test was used to determine the relationship between sociodemographic factors such as age, gender, DMF-T score, and use of dentures with masticatory performance.

RESULTS

A total of 152 subjects met the inclusion criteria. The mean DMF-T score in this study was 6.24 points, with a mean decayed score (D) of 1.77 points, a mean missing score (M) of 3.03 points, and a mean filling score (F) of 1.45 points. A total of 49 subjects (32.2%) did not have tooth loss, while 85 subjects (55.9%) had between 1 and 8 missing teeth. Of the 152 subjects, 29 (19.1%) used dentures; this consisted of 14 (9.2%) users of partially removable dentures, 10 (6.6%) users of fixed

Table 1. Overview of subjects based on age, gender, DMF-T score, masticatory performance, denture type, and denture condition

Variable		n (%)
Gender	Male	60 (39.5)
	Female	92 (60.5)
Age	17-25	60 (39.5)
	26-35	61 (40.1)
	≥ 46	31 (20.4)
Decayed teeth	< 2	79 (52.0)
	2-3	73 (48.0)
	≥ 4	14 (9.0)
Missing teeth	0	49 (32.2)
	1-8	85 (55.9)
	9-32	18 (11.8)
Filled teeth	< 6	149 (98)
	≥ 6	3 (2.0)
Masticatory performance	1 (Very poor)	0 (0)
	2 (Poor)	18 (11.8)
	3 (Adequate)	55 (36.2)
	4 (Good)	62 (40.8)
	5 (Very good)	17 (11.2)
Denture use	Partially removable denture	14 (9.2)
	Fixed denture	10 (6.6)
	Combination of removable and fixed dentures	5 (3.3)
	No denture use despite having tooth loss	76 (50.0)
	No tooth loss	47 (30.9)
Denture condition	Good	16 (55.2)
	Poor	13 (44.8)

dentures (n = 10; 6.6%), and 5 (3.3%) subjects who used a combination of removable and fixed dentures. In this study, 17 subjects (11.2%) displayed very good masticatory performance, 62 (40.8%) had good masticatory performance, 55 (36.2%) had adequate masticatory performance, and 18 subjects (11.8%) had poor masticatory performance. Table 1 shows the characteristics of the study subjects.

Table 2 shows the association between masticatory performance and various factors. The “very poor” masticatory performance group was not shown in this table as none of the subjects had very poor masticatory performance. As presented in Table 2, masticatory performance decreased with age. Good masticatory performance was mostly found in the age range of 17 to 25 years (51.7%); conversely, only five subjects (16.1%) aged 46 years or older in our study cohort demonstrated

good masticatory performance. On the basis of missing tooth scores, poor masticatory performance was most often experienced by subjects with nine or more missing teeth (33.3%). In this analysis, the subjects were classified into three groups based on their denture use: denture users (including both fixed or removable dentures), subjects who had tooth loss but did not use dentures, and subjects with no tooth loss. Among 76 subjects who experienced tooth loss but did not use dentures, 33 subjects (43.4%) experienced good masticatory performance and 6 subjects (7.9%) experienced very good masticatory performance.

DISCUSSION

To date, masticatory performance testing has not been widely performed in Indonesia. A previous study in Indonesia used a questionnaire to conduct subjective assessments of masticatory performance, which were only performed for an elderly population of denture users.¹¹ Objective assessments using color-changeable chewing gum for various groups that more specifically analyze the relationship between masticatory performance and denture use and compare denture users with individuals without tooth loss have not been performed as much.

In this study, no inter-sex differences were noted in masticatory performance, which is contrary to a previous study suggesting that men have a higher number of jaw movements, greater muscular and occlusal force, and, hence, masticatory performance than women.¹³ This study observed that older age was significantly associated with reduced masticatory performance. It has also been postulated that masticatory performance is affected by age as the number of cycles and time required to chew food increases with age. This aging process is characterized by tooth loss and decreases in sensory and motor abilities, salivary flow rate, and occlusal force; thus, it is expected that mastication ability will decrease with age.¹⁴ Herein, on the basis of the chewing-gum color score, an indicator of masticatory performance, it was found that 62 (40.8%) and 55 (36.2%) subjects demonstrated good and adequate mastication abilities, respectively. Thus, it can be concluded that most of our adolescent and adult subjects had at least adequate masticatory performance.

The decayed and filled tooth scores were not significantly associated with masticatory performance. This result is in line with studies conducted by Ikebe et al., who concluded that the number of remaining teeth in the oral cavity affected masticatory performance.¹⁵ Masticatory performance is still considered satisfactory when there are at least 20 teeth in the oral cavity (i.e., three to four pairs of teeth that are positioned symmetrically).¹⁶ A study by Yamashita et al. concluded that masticatory function in denture wearers is associated with the type

Table 2. The association between masticatory performance and various factors

Variable	n	Masticatory performance				p-value
		Poor (2)	Adequate (3)	Good (4)	Very good (5)	
Gender						
Male	60	4 (6.7)	20 (33.3)	28 (46.7)	8 (13.3)	0.294
Female	92	14 (15.2)	35 (38)	34 (37)	9 (9.8)	
Age						
17-25	60	3 (5)	18 (30)	31 (51.7)	8 (13.3)	0.001*
26-45	61	6 (9.8)	20 (32.8)	26 (42.6)	9 (14.8)	
≥ 46	31	9 (29)	17 (54.8)	5 (16.1)	0 (0)	
Decayed teeth						
< 2	79	8 (10.1)	26 (32.9)	34 (43)	11 (13.9)	0.531
≥ 2	73	10 (13.7)	29 (39.7)	28 (38.4)	6 (8.2)	
Missing teeth						
None	49	0 (0)	17 (34.7)	23 (46.9)	9 (18.4)	0.001*
1-8	85	12 (14.1)	29 (34.1)	36 (42.4)	8 (9.4)	
9-32	18	6 (33.3)	9 (50)	3 (16.7)	0 (0)	
Filled teeth						
< 6	149	17 (11.4)	54 (36.2)	61 (40.9)	17 (11.4)	0.663
≥ 6	3	1 (33.3)	1 (33.3)	1 (33.3)	0 (0)	
Denture condition						
Good	16	1 (6.3)	8 (50)	4 (25)	3 (18.8)	0.053
Poor	13	6 (46.2)	5 (38.5)	2 (15.4)	0 (0)	
Denture use						
Yes	29	7 (24.1)	13 (44.8)	6 (20.7)	3 (10.3)	0.012*
No denture use despite having tooth loss	76	11 (14.5)	26 (34.2)	33 (43.4)	6 (7.9)	
No tooth loss	47	0 (0)	16 (34)	23 (48.9)	8 (17)	

* statistically significant

of dentures used and the number of teeth that are in contact in the premolar and molar areas.¹⁷ Moreover, Bessadet et al. reported that subjects with partial tooth loss cannot produce the same food bolus particle size as subjects with all original teeth intact.¹⁸ Other studies have noted that the use of fixed dentures provides better masticatory performance results relative to removable dentures.^{17,19} In this study, subjects who used dentures (29 subjects) were compared with subjects who had tooth loss but did not replace their missing teeth with dentures (76 subjects). The results showed that masticatory performance was higher in the latter group. This may be because most of the subjects with tooth loss in this study still had good occlusion contact on the posterior side, which did not compromise their masticatory performance.

In addition, this study shows that denture condition did not significantly influence masticatory performance. However, it was found that dentures in good condition were most common in subjects with 24 months or fewer of denture use. This result suggests that the quality of dentures decreases with a longer duration of use, indicating that periodic quality control among denture wearers is warranted. By observing changes in the color of the color-changeable chewing gum, clinicians

can easily check the quality of their patients' dentures without using special tools.²⁰

This study has several limitations. The examination of masticatory performance on the basis of the color evaluation of color-changeable chewing gum was only performed once for each subject. Additionally, the cross-sectional method used in this study cannot explain causal relationships or changes in mastication ability resulting from the use of dentures in subjects with tooth loss. The data from this study are not generalizable to other populations because the subjects of this study were only from a single dental hospital in Jakarta. Further randomized clinical trials should be conducted in an attempt to answer these outstanding considerations. Moreover, there are other factors that influence masticatory performance beyond the variables that were investigated in this study. These factors, such as tongue movement and the functioning of the lips, bite force, saliva, and subjective factors, such as the patient's perception of the ability to chew and quality of life, are also believed to play an important role in the function of mastication.¹⁴ Therefore, in further research, these variables need to be examined with regard to their effect on masticatory performance.

CONCLUSION

From this study, it can be concluded that masticatory performance is affected by age, tooth loss, and denture use. Conversely, other factors such as gender, decayed and filled tooth scores, and denture condition did not affect masticatory performance. Masticatory performance assessments should be performed in daily practice as part of a set of diagnostic procedures so that clinicians can observe differences in masticatory performance before and after dental treatment and better gauge treatment success.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

REFERENCES

1. Endo T, Komatsuzaki A, Kurokawa H, Tanaka S, Kobayashi Y, Kojima K. A two-colored chewing gum test for assessing masticatory performance: A preliminary study. *Odontology* 2014;102(1):68-75.
2. Prithviraj D, Vashisht R, Harshamayi P, Kumar Cg, Madan V. A comparison of masticatory efficiency in conventional dentures, implant retained or supported overdentures and implant supported fixed prostheses: A literature review. *J Oral Rehabil* 2014;4(2):153-7.
3. Calliandra, Saptarini, Riyanti. Masticatory Performance in Children with High and Low Caries Index. *E J Dent* 2014;4(2):581-4.
4. De Abreu RAM, Pereira MD, Furtado F, Prado GPR, Mestriner W, Ferreira LM. Masticatory efficiency and bite force in individuals with normal occlusion. *Arch Oral Biol* 2014;59(10):1065-74.
5. Ikebe K, Matsuda K, Morii K, Furuya-Yoshinaka M, Nokubi T, Renner RP. Association of masticatory performance with age, posterior occlusal contacts, occlusal force, and salivary flow in older adults. *Int J Prosthodont* 2006;19(5):475-81.
6. Hsu K-J, Lee H-E, Lan S-J, Huang S-T, Chen C-M, Yen Y-Y. Evaluation of a self-assessed screening test for masticatory ability of Taiwanese older adults. *Gerodontology* 2012;29(2):e1113-20.
7. Tumrasvin W, Fueki K, Yanagawa M, Asakawa A, Yoshimura M, Ohyama T. Masticatory function after unilateral distal extension removable partial denture treatment: intra-individual comparison with opposite dentulous side. *J Med Dent Sci* 2005;52(1):35-41.
8. Koshino H, Hirai T, Ishijima T, Ohtomo K. Influence of mandibular residual ridge shape on masticatory efficiency in complete denture wearers. *Int J Prosthodont* 2002;15(3):295-8.
9. Tarkowska A, Katzer L, Ahlers MO. Assessment of masticatory performance by means of a color-changeable chewing gum. *J Prosthodont Res* 2015;61(1):9-19.
10. Kamiyama M, Kanazawa M, Fujinami Y, Minakuchi S. Validity and reliability of a Self-Implementable method to evaluate masticatory performance: Use of color-changeable chewing gum and a color scale. *J Prosthodont Res* 2010;54(1):24-8.
11. Riadiani B, Dewi RS, Ariani N. Tooth Loss and Perceived Masticatory Ability in Post-Menopausal Women. *Journal of Dentistry Indonesia* 2014;21(1):11-5.
12. Kimura Y, Ogawa H, Yoshihara A, et al. Evaluation of chewing ability and its relationship with activities of daily living, depression, cognitive status and food intake in the community-dwelling elderly. *Geriatr Gerontol Int* 2013;13(3):718-25.
13. Ishikawa Y, Watanabe I, Hayakawa I, Minakuchi S, Uchida T. Evaluations of masticatory performance of complete denture wearers using color-changeable chewing gum and other evaluating methods. *J Med Dent Sci* 2007;54(1):65-70.
14. Ikebe K, Matsuda K, Kagawa R, et al. Association of masticatory performance with age, gender, number of teeth, occlusal force and salivary flow in Japanese older adults: Is ageing a risk factor for masticatory dysfunction? *Arch Oral Biol* 2011;56(10):991-6.
15. Ikebe K, Matsuda K, Kagawa R, et al. Masticatory performance in older subjects with varying degrees of tooth loss. *J Dent* 2012;40(1):71-6.
16. Sierpińska T, Gołbiewska M, Długosz JW. The relationship between masticatory efficiency and the state of dentition at patients with non rehabilitated partial lost of teeth. *Adv Med Sci* 2006;51:196-9.
17. Yamashita S, Sakai S, Hatch JP, Rugh JD. Relationship between oral function and occlusal support in denture wearers. *J Oral Rehabil* 2000;27(10):881-6.
18. Bessadet M, Nicolas E, Sochat M, Hennequin M, Veyrune J-L. Impact of removable partial denture prosthesis on chewing efficiency. *J Appl oral Sci* 2013;21(5):392-6.
19. Rosa LB. Bite force and masticatory efficiency in individuals with different oral rehabilitations. *Open J Stomatol* 2012;2(01):21-6.
20. Mac-Kay APMG, Véliz LOC, Calderón CSM, et al. Chewing alteration in removable dental prosthesis users: systematic review. *Rev CEFAC* 2015;17(4):1319-26.

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