

Association between the number of bilateral free-end posterior tooth loss and mastication performance in RSGM USU patients

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ABSTRACT. Mastication is the process of mechanically crushing food to form soft particles, facilitating the ingestion process in providing nutrients to the body. One of the objectively assessed mastication functions is mastication performance. The number of tooth losses is one factor that affects mastication performance; the more tooth loss, the lower the mastication performance. Posterior teeth play an important role in mastication function, and loss of posterior teeth decreases mastication performance. The research aims to determine the association between the number of bilateral free-end posterior tooth loss and mastication performance. This type of research is descriptive-analytic with a cross-sectional design. The subjects in this research were 17 people. Data were collected by examining the oral cavity and color-changeable chewing gum to assess mastication performance using a colorimeter. Data were analyzed using the Mann-Whitney test. The results showed that all subjects with bilateral free-end posterior teeth loss in one and both arches had poor mastication performance. The statistical test results showed no association between the number of bilateral free-end posterior teeth loss and mastication performance in one and both arches with $p = 1,000$ ($p > 0.05$). It can occur because this research does not pay attention to the number of occlusion pairs of posterior teeth and the results of the assessment of mastication performance are not quantitative. The number of bilateral free-end posterior tooth loss can be considered in assessing mastication performance as an educational basis for denture care.

KEYWORDS: Posterior Bilateral Free End, Mastication Performance

INTRODUCTION

Tooth loss is the loss of one or more teeth from their socket or place due to various causes, including periodontal disease, dental caries, and external injury. Its prevalence increases with age. Based on the Basic Health Research (Riskesdas) in 2018, the prevalence of tooth loss in Indonesia was 19%, with the highest percentage at the age of 65 years and over, which was 30.6%, followed by the age of 55-64 years, which was 29%. Tooth loss can cause disturbances in aesthetics, phonetics, and mastication. Therefore, denture treatment is needed to rehabilitate and maintain masticatory, aesthetic, and phonetic functions.^{1,2,3}

Mastication is the process of mechanically crushing food to form a small bolus to facilitate the swallowing process in providing nutrients for the body. The components of mastication consist of the dentition, temporomandibular joint, nervous

system, and masticatory muscles. The functions of mastication include cutting, crushing, mixing food, and stimulating salivary secretion.^{4,5} Mastication is influenced by several factors, including saliva, gender, age, supporting tissue, and the amount of tooth loss. One assessment of masticatory function that can be objectively assessed is masticatory performance.⁶

Mastication performance is a measure of the distribution of food that can be achieved under standardized testing conditions and indicates the comprehensive ability required for mastication. Mastication performance consists of cutting, crushing, and mixing food, but none of the three functions can be evaluated at once. Nasser's (2017) study found a relationship between crushing and food mixing ability, so both can be used to evaluate mastication performance.^{6,7,8,9} There are several

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methods available to objectively evaluate mastication performance, one of which is using color-changeable chewing gum. This method is more focused on food mixing ability and has the advantages of being simple and fast, and has proven reliability and validity to evaluate masticatory performance by measuring gum color changes.^{10,11,12,13}

One factor that affects mastication is tooth loss. Permanent teeth in adults consist of 32 teeth, 16 in the upper jaw and 16 in the lower jaw. The total number of anterior teeth is 12, and the posterior teeth are 20 if the entire M3 erupts. Tooth loss can be classified based on the number of tooth loss quadrants, Kennedy's classification, and the amount of posterior tooth loss. Dental quadrant is a term used in the division of the jaw into four equal parts, starting from the center line of the dental arch or the contact point of the central incisor and extending towards the last tooth at the back of the mouth, consisting of four quadrants, namely, the upper right, upper left, lower left and lower right quadrants. Kennedy's classification is based on the relationship of the edentulous space to the supporting teeth. This classification divides all toothless conditions into class I (bilateral free end), class II (unilateral free end), class III, and class IV. Posterior tooth loss is prone to occur in a person due to difficulties in performing efficient dental hygiene and generating considerable occlusal forces when used, so the loss of posterior teeth has a major impact on masticatory function.^{14,15,10,16} If in a bilateral free end state, it will cause difficulty and limitations in mastication so that a person tends to advance the chin and result in occlusion instability which has an impact on masticatory function and jaw movement processes.^{17,18,19,20}

Good occlusion should allow the mandible to translate without occlusal resistance during functional movements, especially the posterior part,

so that the load distribution is more even.²¹ Occlusion and mandibular position will be expected and stable if each masticatory component can carry out its activities, usually with harmonious and balanced interactions. It is because a disturbance in one component of the masticatory system will impact other components.²² In Krista's research (2016) showed that loss of posterior teeth that are not replaced will cause impaired function of the masticatory muscles, impacting the mastication process.²³ Another thing that can occur is a decrease in the thickness of the masseter muscle in someone who loses a tooth, causing a decrease in bite force.²⁴

In the study of Hayato et al. (2014), there were differences in mastication performance between the bilateral posterior tooth loss group and the group that did not lose posterior teeth, which showed a decrease in mastication performance in the bilateral posterior tooth loss group. Still, in this study, there was no division of bilateral posterior tooth loss by number.¹⁵ Muslita's research (2018) shows that there is an effect of the number of teeth that still have occlusal contact in the oral cavity with masticatory performance, while Ikebe et al.'s research (2011) shows that the more the number of missing teeth and the less the number of remaining teeth in the oral cavity, the lower a person's masticatory performance, but in these two studies there was no division of missing teeth based on location.^{4,7} Wardhana et al.'s research (2015) divided the number of posterior tooth losses into <3 and ≥ 3 teeth, showing the results that individuals who lost more than three posterior teeth experienced interference, limitation, or pain in the function of the oral cavity, but there was no division of tooth loss based on location.^{15,21} Based on the description of these studies, there is a relationship between the number and location of tooth loss with masticatory performance.

MATERIALS AND METHODS

This type of research is descriptive-analytic using a cross-sectional research design. This research was conducted at the Department of Prosthodontics in February-March 2020. The population of this study was 2019-2020 USU RSGM patients. Sampling using purposive sampling technique, namely setting inclusion criteria and exclusion criteria. The inclusion criteria in the study were patients with bilateral free end posterior tooth loss $\geq 2 - 4$ and >4 teeth in one jaw arch, bilateral free end posterior tooth loss $\geq 4 - 10$ and >10 teeth in both jaw arches, willing to be respondents in the study,

not paying attention to Kennedy's classification modification. Exclusion criteria are patients using maxillary and mandibular GTP (full tooth loss) and patients who are not willing to be respondents. The subjects in this study totaled 17 people. The tools and materials used in the study were standard intraoral examination tools (mouth glass, tweezers, sonde), preparation glass, colorimeter, color scale, hand tally counter, and color-changeable chewing gum.

Examination of the Number of Bilateral Free-end Posterior Tooth Losses

Conduct an oral examination to see the number of bilateral free-end posterior tooth losses and record and classify the examination results based on the tooth loss group.

Mastication Performance Check

Subjects were instructed to rinse their mouth, then chew color-changeable chewing gum 120 times. The chewed gum was taken and flattened on polyethylene film and then compressed between two glass preparations to a thickness of approximately 1.5 mm to see the even distribution of color change. The color change was measured using a colorimeter. Chewing gum was measured immediately after leaving the patient's mouth. The measurement results were converted into the formula:

$$\Delta E = \sqrt{(Lx - 72,3)^2 + (ax + 14,9)^2 + (bx - 33,0)^2}$$

The ΔE value indicates the color change to see the mastication performance. The ΔE value is divided into 0 to 70 with an interval of 7 and a color scale ranging from 1-11 shades. Color shades 1-3 are score 1 (green), color shades 4-5 are score 2 (yellow), color shades 6-7 are score 3 (pink), color shades 8-9

are score 4 (red), color shades 10-11 are score 5 (dark red). Then the subjects were categorized into mastication performance scores, namely good (score 4-5) and bad (score 1-3).



Figure 1. Color-changeable chewing gum²⁵

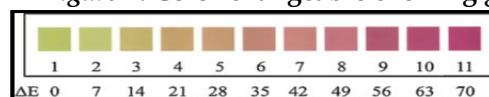


Figure 2. Color scale based on ΔE value²⁵

Data Analysis

Descriptive data, namely the percentage of bilateral free-end posterior tooth loss in one jaw arch and both jaw arches and mastication performance values, were presented in tabular form. Analytical data, namely the relationship between the amount of bilateral free-end posterior tooth loss and mastication performance, were analyzed using the Mann-Whitney test to see the relationship between variables ($p < 0.05$).

RESULTS

The results of data collection on the prevalence of bilateral free-end posterior tooth loss in **Table 1** show that in one jaw arch from a total of 9 patients, four people (44.4%) had a loss of $\geq 2-4$ bilateral free-end posterior teeth. Five people (55.6%) had a loss of > 4 bilateral free end posterior teeth. **Table 2** data in

both jaw arches showed that out of a total of 8 patients, one person (12.5%) had a loss of $\geq 4-10$ posterior teeth bilateral free end, and seven people (87.5%) had a loss of > 10 posterior teeth bilateral free end

Table 1. Prevalence of Bilateral Free-end Posterior Tooth Loss in One Jaw Arch

Jaw Arch	Number of Bilateral Free-end Posterior Tooth Losses				Total
	≥2-4 Tooth		> 4 Tooth		
	n	%	n	%	
One jaw arch (maxilla/ mandible)	4	44,4	5	55,6	9 (100%)
Total	4	44,4	5	55,6	9 (100%)

Table 2. Prevalence of Bilateral Free-end Posterior Tooth Loss in Both Jaw Arches

Jaw Arch	Number of Bilateral Free-end Posterior Tooth Losses				Total
	≥4-10 Tooth		> 10 Tooth		
	n	%	n	%	
Both jaw arches (maxilla and mandible)	1	12,5	7	87,5	8 (100%)
Total	1	12,5	7	87,5	8 (100%)

The results of data collection on the prevalence of mastication performance in **Table 3** patients who lost bilateral free end posterior teeth in one jaw arch showed a total of 9 people all had poor mastication

performance (100%) and in both jaws showed a total of 8 people all had poor mastication performance (100%).

Table 3. Prevalence of Mastication Performance in Patients with Bilateral Free-end Posterior Tooth Loss

Jaw Arch	Mastication Performance				Total
	Good		Bad		
	n	%	n	%	
One jaw arch (maxilla/ mandible)	0	0	9	100	9 (100%)
Both jaw arches (maxilla and mandible)	0	0	8	100	8 (100%)

Based on **Table 4** of the statistical analysis results below, one jaw arch shows no relationship between the amount of bilateral free-end posterior tooth loss and mastication performance, with a $p =$

1.000 ($p > 0.05$). Both jaw arches also showed no relationship between the amount of bilateral free-end posterior tooth loss and mastication performance, with a value of $p = 1.000$ ($p > 0.05$)

Table 4. Association Between the Number of Bilateral Free-end Posterior Tooth Loss and Mastication Performance

Number of Bilateral Free-end Posterior Tooth Losses	Mastication Performance				Total		p
	Good		Bad				
	n	%	n	%	n	%	
One jaw arch (maxilla/ mandible)							1,000
≥2-4 Gigi	0	0	4	44,4	4	44,4	
>4 Gigi	0	0	5	55,6	5	55,6	
Total	0	0	9	100	9	100	
Both jaw arches (maxilla and mandible)							1,000
≥4-10 Gigi	0	0	1	12,5	1	12,5	
>10 Gigi	0	0	7	87,5	7	87,5	
Total	0	0	8	100	8	100	

DISCUSSION

This study examined the number of bilateral free-end posterior tooth losses. The examination was carried out in patients with bilateral free-end posterior tooth loss in one jaw arch and two jaw arches because at least 20 teeth are the antagonistic pair needed to ensure good mastication. The occlusal contact of the remaining posterior teeth is key in predicting the decline in mastication ability.^{12,26} Mastication performance is a measure of the distribution of food that can be achieved under standardized testing conditions and indicates the comprehensive ability required for mastication, consisting of cutting, crushing, and mixing food.⁶ In this study, the assessment of mastication performance was divided into two, namely, good and bad. The amount of tooth loss is one factor that affects masticatory performance, which means that the greater the amount of tooth loss, the lower the masticatory performance.^{6,7} Posterior teeth, namely molars and premolars, play an essential role in masticatory function, so the loss of posterior teeth will have an impact on reducing masticatory performance. If in a bilateral

free end state, a person tends to use anterior teeth to replace their function so that they tend to advance the chin and cause instability.^{18,19,20} The number of remaining teeth in occlusion also affects masticatory function because the smaller the number of remaining teeth in occlusion, the lower the masticatory performance.²⁶

The results of the study in tables 1 and 2 show that the prevalence of bilateral free end posterior tooth loss in one jaw arch is more dominant in losing > 4 teeth (55.6%) and in both jaw arches is more prevalent in losing > 10 teeth (87.5%). The results of this study are in line with the research of Peres et al. (2014), which shows the prevalence of tooth loss is more dominant in losing > 4 teeth or the number of remaining teeth < 10 teeth in one jaw arch, while in both jaw arches the prevalence of tooth loss is more dominant in losing > 10 .²⁷

The results of the study in table 3 show that the prevalence of mastication performance experiencing bilateral free end posterior tooth loss ≥ 2 teeth in one jaw arch and ≥ 4 in both jaw arches has poor mastication performance (100%). The

results of the statistical analysis in table 4 show that there is no relationship between the number of bilateral free-end posterior tooth loss and masticatory performance in one jaw arch with $p = 1.000$ ($p > 0.05$) and no relationship between the number of bilateral free end posterior tooth loss and masticatory performance in both jaw arches with $p = 1.000$ ($p > 0.05$). These results indicate that a small or large amount of bilateral free-end posterior tooth loss has poor masticatory performance. This may occur because this study did not pay attention to the number of remaining occluded posterior teeth. After all, in addition to the number and location of teeth that affect masticatory performance, the number of occlusion pairs of posterior teeth also affects masticatory performance.

The results of the mastication performance assessment were also categorized in qualitative form, namely good or bad, not in quantitative form (numbers), so it did not show that the greater the amount of tooth loss, the lower the mastication performance score. The results of this study are in line with research by Wardhana et al. (2015), showing that a person who loses more than three posterior teeth in one jaw arch experiences interference, limitation, or pain in the function of the oral cavity, and this study the function of the oral cavity is included in the function of mastication.²¹ This shows that mastication performance in bilateral free-end posterior tooth loss in one jaw arch also has the same effect on both jaw arches. This occurs because the mastication process requires occlusion contact in both jaw arches, so the loss of occlusion contact from the antagonist's teeth causes a decrease in mastication performance.

The results of this study are not in line with the research of Ikebe et al. (2011), which shows that there is a relationship between the number of

remaining teeth in the oral cavity and masticatory performance, but in that study, there was no division of the number of remaining teeth in the oral cavity based on the location of the teeth and had a large sample size, while in this study dividing the amount of tooth loss based on location, namely posterior bilateral free end by not paying attention to the amount of tooth loss in other locations and having a minimal sample size so that it might affect the accuracy of the results of this study. In Muslita's research (2018) there was an influence on the number of occlusion pairs of posterior teeth with masticatory performance in that study subjects with the criteria had no loose teeth, no tooth loss, or only lost one tooth and had good occlusion, while in this study it did not pay attention to the number of occlusion pairs of posterior teeth with subject criteria, namely no loose teeth, good occlusion, and more than one tooth loss, so it might affect the accuracy of the results of this study.^{4,7}

The weaknesses in this study are the minimum sample size due to the limited number of patients who fit the inclusion criteria, the number of free-end bilateral posterior tooth loss does not take into account the number of occlusion pairs of posterior teeth, the results of mastication performance assessment are not in quantitative form (numbers), uncontrolled variables such as saliva, systemic diseases, psychological effects and modification of Kennedy's classification. It may affect the accuracy of the results. Therefore, if this study is continued, it is necessary to control these variables with a larger sample size and pay attention to the number of occlusion pairs of the posterior teeth and the results of the mastication performance assessment in quantitative form (numbers) to show lower or higher mastication performance.

CONCLUSION

Based on the results of this study, in addition to the number and location of teeth affecting masticatory performance, the number of occlusion pairs of posterior teeth also affects masticatory

performance. The amount of bilateral free-end posterior tooth loss can be taken into consideration in assessing masticatory performance as a basis for education to perform denture treatment

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