Tooth Loss Observation in Patients with Periodontitis in Recall Period based on the Staging and Grading System of a World Classification 2017

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Abstract

Periodontitis is a disease revolving around inflammation and result in destruction of gingiva, periodontal tissue, and alveolar bone which function as anchorage of teeth. Past studies tried to use periodontal risk assessment tools to predict tooth loss. The new classification of periodontal disease, World Classification 2017, categorized periodontitis into stages and grades based on parameter such as bone loss, which also a risk factor of tooth loss. so it was considered to be potential periodontal tooth loss predictor.

To investigate relationship between diagnosed periodontitis stages and grades on baseline to tooth loss on 1-3 months, 4-6 months, 7-9 months, 10-12 months, and 13-24 months recall.

This study is done retrospectively using secondary data from 2018-2021 at Dental Teaching Hospital Universitas Indonesia. One hundred sixty six samples collected for the study. Data is analyzed by comparative test using IBM SPSS Statistics 26 Program.

There is significant difference of tooth loss by periodontitis stage IV between 1-3 months to 13-24 months recalls from baseline; grade A between 1-3 months to 13-24 months; grade C between 13-24 months to 1-3 months, 4-6 months, and 10-12 months recalls from baseline. Conclusions: Tooth loss due to periodontitis is differ based on stages and grades between recalls.

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Introduction

Periodontal disease is defined as a disease that specifically affects the gingiva, the connective tissue supporting the teeth, and the alveolar bone where the teeth in the jaw rest. Disease is divided according to the area involved in the disease process: involving the gingiva only and involving destruction of the underlying periodontium. Based on this statement, periodontal disease involving the gingiva only is called gingivitis and is characterized by redness, swelling, change in the position of the gingival margin, and bleeding when brushing teeth or probing the gingival sulcus.[1] The swelling process is stimulated by the presence of microbial biofilms and is caused by the body's response to it in the form of inflammation. [2]

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Gingivitis can progress to involve the periodontal ligament and alveolar bone, a condition known as periodontitis.[1] The bacteria *Porphyromonas gingivalis (P. gingivalis), Treponema denticola (T. denticola*), and *Tanerella forsythia (T. forsythia)*, also known as red complex, is considered as the main pathogen that plays a role in the development of periodontitis.[2] Manifestations of the disease in the form of loss of connective tissue, alveolar bone resorption, and periodontal pockets. If this condition is allowed to develop, mobility and even tooth loss can occur.[1]

Patients with periodontitis in Indonesia alone amount to about 74.1%, showing how high the prevalence of this disease is.[3] Periodontitis can cause tooth loss and disability, where individuals who experience it will have difficulty chewing and reduce facial aesthetics so that the quality of life decreases.[4] According to the 2018 Indonesian Basic Health Research (RISKESDAS), 19% of Indonesians experience tooth loss problems, whether intentional or not, and 10.4% have problems with tooth mobility. The higher figure is found in the DKI Jakarta area, where 18.4% of the population has problems

losing their teeth and 11.9% has problems with tooth mobility. 7.9% of Indonesians who visit the dentist for dental and oral problems receive tooth extraction treatment, while in the province it is higher than the national average with a proportion of 9.6%.[3] Although these data do not describe specifically, the data are can be an early picture of cases of tooth mobility and tooth loss due to periodontitis. According to the study of Ramseier et al in a study of the development of periodontitis in a group of subjects for 40 years, there was an average tooth loss due to periodontitis of 13.1.[5]

The classification of periodontal diseases, including periodontitis, has been developed by the American Academy of Periodontology (AAP) for decades and is still evolving. Several classifications have been made such as AAP 1986, AAP 1989, AAP 1999, and most recently the World Classification 2017 by AAP and the European Federation of Periodontology (EFP) at the World Workshop 2017. Before the World Classification 2017 was made, periodontitis was still classified according to the AAP 1999, namely chronic periodontitis and aggressive periodontitis.[6] This classification was later replaced by the latest classification system, in which chronic and aggressive periodontitis are only classified into 1 disease, namely periodontitis, but are distinguished based on the staging and grading of the periodontitis.[4] This change was made because of the finding that although they have differences clinical features such as extent and severity, chronic and aggressive periodontitis do not differ in aetiology and pathophysiology.[7] This finding causes the previous classification to be considered unsuitable because it does not reflect important information possessed by each sick individual, such as the effect of h the severity of the disease to therapy, the risk factors that influence the disease, and the measurement of knowledge and skills that must be possessed to treat the disease. In addition, in Tonetti et al, the rate of progression of periodontitis observed in a group of populations around the world has a similar rate. Differences in the rate of progression of periodontitis were only found in certain subgroups when the population was divided by age. The conclusion was drawn in the 2017 World Workshop that there is still insufficient evidence to separate chronic and aggressive periodontitis into distinct diseases.[8]

Various types of periodontal treatment exist and are practiced today, but not every individual with periodontitis responds to periodontal treatment in the same way.9 Various studies have been carried out to develop risk factor research tools and specific risk factors associated with loss tooth. These findings made it possible to estimate the risk of tooth loss. [8] In a systemic review by Lang et al, a risk factor assessment tool developed by Page et al called the periodontal risk calculator (PRC) that considers nine risk factors to determine a score of 1-5, with a score of 1-5. One indicates the patient has the lowest risk. The study concluded that a score of 2 represents a risk of losing 0.5 teeth, a score of 3 is at risk of losing 1.6 teeth, a score of 4 is at risk of losing 2.4 teeth, and a score of 5 is a risk of losing 5.8 teeth. Matuliene et al tested a risk factor assessment tool developed by Lang et al called the periodontal risk assessment model (PRA) which considers 8 factors to determine patient risk groups: low, moderate, and high risk. The study found that 1.18 ± 1.9 teeth were lost in the low risk group, 1.02 ± 1.8 teeth in the moderate risk, and 2.59 ± 3.9 teeth in the high risk group.[9]

Now a new study is emerging that assesses the ability of the periodontitis classification system generated at the 2017 World Workshop to estimate the prognosis of patient tooth loss. A study by Ravida et al in 2020 showed that the increase in tooth loss was directly proportional to the stage and grade of periodontitis experienced by the patient.10 In a follow-up study by Ravida et al in 2021, a 10-year observational study concluded that grade significantly predicts tooth loss in stage IV patients, whereas stage significantly predicts tooth loss in grade B and C patients.[11] Therefore, the authors aimed to analyze and predict tooth loss based on the periodontitis staging and grading system in the 2017 World Classification in determining the prognosis of tooth loss at the Dental Teaching Hospital Universitas Indonesia.

Materials and methods

Ethical clearance was obtained from the Ethical Committee, Faculty of Dentistry, Universitas Indonesia (KEPKG) NO: 016/UN2.F2.RSKGM/PPM.00/2021. The study was carried out with a retrospective study design with secondary data and using comparative

inferential statistical analysis to determine the difference between the variables of missing teeth due to periodontitis and OHIS (Oral hygiene index simplified) based on the stage and grade of periodontitis in the first treatment and at follow-up 1-3 months, 4-6 months, 7-9 months, 10-12 months, and 13-24 months. Inclusion criteria as follows, periodontal medical records for the year of 2018-2021 with a complete diagnosis of periodontitis, patients aged 20-64 years old at the first periodontal treatment visit, medical records of patients with a follow-up history of 1-3 months, 4-6 months, 7-9 months, 10-12 months, and 13-24 months. While, the exclusion criteria in this study are medical records of patients who were not treated and who do not meet the follow-up phase. The medical records of the included patients were then recorded with data related to age, risk factors for periodontitis, stage and grade of periodontitis, date of visit, OHIS, and number of missing teeth. The data were then analyzed using SPSS and presented in the following tables. Data normality test was carried out for each variable tested in this study.

Results

There were 166 medical records of patients with a diagnosis of periodontitis based on the 2017 World Classification. In the present study, based on age, the majority of the samples were in the 20-44 year old group with a total of 93 samples (56%), while the 45-64 year old sample was 73 (44%). The majority of the study sample had no risk factors for pre-diabetes, diabetes, smoking, and/or obesity with a total of 102 (61.4%), while the rest had at least one risk factor with a total of 64 (38.6%).

Stage	*Grade* A	B	C	Total
I	9 (5.4%)	3 (1.8%)	0 (0.0%)	12 (7.2%)
II	14 (8.4%)	17 (10.2%)	1 (0.6%)	32 (19.3%)
III	6 (3.6%)	40 (24.1%)	40 (24.1%)	86 (51.8%)
IV	1 (0.6%)	12 (7.2%)	23 (13.9%)	36 (21.7%)
Total	30 (18.1%)	72 (43.4%)	64 (38.6%)	166 (100%

Table 1. Distribution based on Diagnosis of Periodontitis World Classification 2017.

Table.1 describes the distribution of the study sample based on the stage and grade of periodontitis diagnosis according to the 2017 World Classification. The results showed that most of the samples were diagnosed with stage-grade IIIB and IIIC periodontitis, each of which was 40 (24.1%), followed by IVC as many as 23 (13.9%) and IIB (10.2%). Of the study sample, none was diagnosed with stage-grade IC periodontitis (0%). Through the analysis, it is known that most of the samples diagnosed with stage III periodontitis were 86 (51.8%), followed by 36 (21.7%), stage II were 32 (19.3%), and the smallest number of samples was in stage I as many as 12 (7.2%). The study also showed that most of the study samples who had periodontitis were diagnosed with grade B which amounted to 72 (43.4%), followed by grade C as many as 64 (38.6%), and with the lowest number grade A amounting to 30 (18.1%).).

Stage	*Grade* A	B	C	Total
I	0 (0%)	0 (0%)	0 (0%)	0 (0%)
II	0 (0%)	0 (0%)	0 (0%)	0 (0%)
III	1 (6.25%)	2 (12.5%)	6 (37.5%)	9 (56.25%)
IV	0 (0%)	0 (0%)	7 (43.75%)	7 (43.75%)
Total	1 (6.25%)	2 (12.5%)	13 (81.25%)	16 (100%)

Table 2. Distribution of Tooth Loss based on Diagnosis of Periodontitis World Classification 2017.

Table.2 provides an overview of the distribution of tooth loss based on the diagnosis of periodontitis. There were 16 cases of tooth loss due to periodontitis in the sample collection. More tooth loss was found in stage III with a total of 9 teeth (56.25%) and in grade III as many as 13 teeth (81.25%). Judging from the stage and grade of periodontitis at the same time, the most tooth loss was found in the IVC group with 7 teeth (43.75%), followed by group IIIC with 6 teeth (37.5%), group IIIB with 6 teeth (37.5%).), and group IIIA with 1 tooth (6.25%).

Recall (Month)	N	OHIS Median (SD)	Tooth Loss Median (SD)
0-3	144	0.64 (0.767)	0.00 (0.189)
3-6	76	0.64 (0.918)	0.00 (0.255)
6-9	48	0.60 (0.818)	0.00 (0.245)
9-12	32	0.55 (0.765)	0.00 (0.000)
12-24	24	0.45 (0.960)	0.00 (0.859)

Table 3. Distribution of Recall Visit, OHIS, and Tooth Loss.

Table.3 shows the number of subjects who returned to the Periodontist Specialist Clinic, RSKGM FKG UI, OHIS, and lost teeth in a predetermined follow-up period. The number of patients who made return visits to the clinic decreased in the follow-up period that was longer than the first visit. The table shows that the number of visits decreases as the follow-up time from the first visit gets farther away. The number of samples who returned to visit from 0-3 months to 12-24 months respectively were 144, 76, 48, 32, and 24 subjects. The oral hygiene of the

samples seen from the median OHIS per follow-up time period seemed to improve with increasing time. OHIS at 0-3 months and 3-6 months follow-up were both 0.64 with standard deviations of 0.767 and 0.918, decreasing to 0.60 (0.818) at 6-9 months follow-up, 0.55 (0.765). at 9-12 months of follow-up, and the lowest at 12-24 months with an index score of 0.45 (0.960). Mean tooth loss appeared to increase with increasing follow-up time period, except at 6-9 months of follow-up where there was a decrease in tooth loss by 0.00 (0.245) and 9-12 months where tooth loss was 0.00 (0.000). The mean tooth loss at 0-3 months follow-up was 0.00 (0.189), 3-6 months was 0.00 (0.255), and 12-24 months was 0.00 (0.859).

Month / Stage	Tooth Loss - Median (SD)					P-Value
	0-3	3-6	6-9	9-12	12-24	
I	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	-	-	1.000
II	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	1.000
III	0.00 (0.260)	0.00 (0.154)	0.00 (0.310)	0.00 (0.000)	0.00 (0.405)	0.075
IV	0.00 (0.000)	0.00 (0.500)	0.00 (0.000)	0.00 (0.000)	0.00 (1.496)	0.010
P-Value	0.581	0.720	0,562	1.000	0.424	

Non-parametric Kruskal-Wallis Test

Table 4. Tooth Loss Comparison based on Stages and Recall Visit

Table.4 summarizes the median and standard deviation of tooth loss data by stage and time period of follow-up along with the results of the comparison test. No significant difference was found in the comparative analysis of tooth loss due to periodontitis between stages at each follow-up ($p > 0.05$). Significant difference in tooth loss due to periodontitis at each stage between follow-up time was only found in stage IV ($p < 0.05$). Further comparative test showed a significant difference between the time period 0-3 months and 12-24 months ($p = 0.003$; $p < 0.05$) where tooth loss in the time period 12-24 months was higher than 0-3 months.

Month / Grade	Tooth Loss - Median (SD)					P-Value
	0-3	3-6	6-9	9-12	12-24	
A	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.500)	0.007
B	0.00 (0.134)	0.00 (0.000)	0.00 (0.218)	0.00 (0.000)	0.00 (0.000)	0.656
C	0.00 (0.260)	0.00 (0.403)	0.00 (0.308)	0.00 (0.000)	0.00 (1.389)	0.002
P-Value	0.775	0.211	0.605	1.000	0.085	

Non-parametric Kruskal-Wallis Test

Table 5. Tooth Loss Comparison based on Grade and Recall Visit.

Table.5 summarizes the median and standard deviation of tooth loss data by grade and time period of follow-up along with the results of the comparative test. No significant difference was found in the comparative analysis of tooth loss due to periodontitis between grades at each follow-up ($p > 0.05$). Significant differences in tooth loss due to periodontitis in each grade between follow-up time were found in grades A and C ($p < 0.05$). A further comparative test showed a significant difference between the 0-3 month and 12-24 month time periods in grade A ($p = 0.003$; $p < 0.05$) where tooth loss in the 12-24 month time period was higher than 0-3 month. Further comparative tests on grade C showed significant differences between the time periods 0-3 months and 12-24 months ($p = 0.000$; $p < 0.05$), 3-6 months and 12-24 months ($p = 0.024$; $p < 0.05$), 9-12 months and 12-24 months ($p = 0.025$, $p < 0.05$). The data showed that tooth loss in the 12-24 month time period was higher than 0-3 months, 3-6 months, and 9-12 months.

Discussion

This present study collected medical records of patients with a diagnosis of periodontitis using the 2017 World Classification system. Based on the stage diagnosis, the sample groups from the most were stage III, IV, II, and I with a total of 86 (51.8%), 36 (21.7%), 32 (19.3%), and 12 (7, 2%). This is in accordance with the research of Ravida, et al (2020) which also used periodontitis patients as research subjects, where the most subjects were the stage III group (50%), followed by grade C and grade A with 64 subjects (38.6%) and 30 subjects (18.1%). Ravida, et al (2020) also have the most subjects in grade B (66.1%).[10]

Medical records included in the study were medical records of subjects aged 20-64 years. In this study, samples from the age group of 20-44 years were 93 subjects (56%) and 45-64 years were 73 subjects (44%). The National Health and Nutrition Examination Survey (NHNES) reported that the prevalence of periodontitis increases with age, in particular an increase in prevalence of 30% in the 30-44 year age group and 60% in the age group 65 years or older.[34] The patient's risk factor status for periodontitis was also investigated, including pre-diabetes, diabetes, obesity, and smoking habits. Sixty-four subjects (38.6%) had risk factors for periodontitis, while the other 102 subjects (61.4%) did not. Suvan, et al (2018) stated that there was an odd ratio of periodontitis incidence

of 1.46 between obese and non-obese patients.[17] The research of Helal, et al. (2019) also stated that smoking and diabetes increase the risk of periodontitis.[28] Kocher, et al (2018) explain in more detail that the level of glycated haemoglobin is a risk factor for periodontitis and not a diagnosis of diabetes.[16]

This study wanted to see the difference between periodontitis and the incidence of tooth loss. From 166 samples, 16 incidents of tooth loss due to periodontitis were found. Nine missing teeth (56.25%) occurred in stage III and seven teeth (43.75%) in stage IV. In terms of grade, the majority of tooth loss occurred in grade C with 13 teeth (81.25%), followed by grade B with 2 teeth (12.5%) and grade A with 1 tooth (6.25%).

Samples were retrospectively observed for tooth loss and OHIS, then grouped according to the time period of the return visit to the Periodontist from the first visit. The frequency of return visits decreased over a time period further than the first visit, i.e. 144 subjects at 0-3 months, 76 subjects at 3-6 months, 48 subjects at 6-9 months, 32 subjects at 9-12 months, and 24 subjects. at 12-24 months. Curi, et al (2018) in their research explain that the use of dental and oral services is based on a person's sense of need for care, including treatment needs assessed by a dentist.[35] As shown in tables 5.4 and 5.5, the frequency of return visits in each group increased in the group. with higher stages and grades, except for stage IV and grade C. According to Ravida, et al (2020) individuals with a stage IV diagnosis may be less willing to undergo treatment because of the complexity or higher cost.[10]

OHIS scores improved at further follow-up time periods: 0.64 (0.767) at 0-3 months, 0.64 (0.918) at 3-6 months, 0.60 (0.818) at 6-9 months, 0.55 (0.765) at 9-12 months, and 0.45 (0.960). This is good news because oral hygiene is one of the main factors controlling periodontal health, especially in individuals with periodontitis. Tooth loss was directly proportional to the longer follow-up period, except at 9-12 months where there was no tooth loss. The median and standard deviation of tooth loss was 0 (0.189) at 0-3 months, 0 (0.255) at 3-6 months, 0 (0.245) at 6-9 months, and 0 (0.859) at 12-24 months. According to Kassebaum, et al (2014) there is an exponential increase in tooth loss with increasing age, and the peak occurs at the age of 60 years.[37]Moreover, Aviandiva, et al (2022) found the effect of smoking habits to periodontal therapy, including OHI care therapy.[38]

Table.3, table.4, and table.5 show the results of the comparative test of missing teeth due to periodontitis based on the diagnosis of periodontitis per follow-up time period and based on the follow-up time in each periodontitis diagnosis group. In the comparison test between stages and time periods, only 1 showed a significant difference: a 12-24 month time period with 0-3 months diagnosed as stage IV. The stage of periodontitis describes the severity and extent of the observed periodontitis, as well as the difficulty of its management. In stage IV, periodontitis has caused considerable damage to the periodontal tissue and is at great risk of causing tooth loss.8 Based on the research of Kassebaum, et al (2014) that tooth loss increases with age, this is reflected in this study on the difference in tooth loss between periods. 12-24 months higher with 0-3 months in the stage IV diagnosis group.[37] This also supports the finding that the comparison test between grades and time periods showed a significant difference in tooth loss between the 12-24 months and 0-3 time periods. months diagnosed grade A.

From the results of the study, tooth loss due to periodontitis was found in all time periods, except at 9-12 months where tooth loss was not found in all study samples. Over a 12-24 month time period, tooth loss appears to be directly proportional to the severity of periodontitis with a stage II-IV diagnosis. Stage I there is no median value (SB) that can be compared because the frequency of visits found is only 1. This finding is in accordance with the study of Graetz, et al (2019) where tooth loss per year per patient was more common in stage IV grade C patients than stage I. III grade C.[27]

Comparative test between grades and time periods also showed significant differences in tooth loss between 12-24 months and 0-3 months, 3-6 months, and 9-12 months for grade C diagnosis. tooth loss always occurred in each grade C time period, except at 9-12 months where no tooth loss was found in the entire study sample. Tooth loss that occurs almost every time period may be due to the high bone loss/age in the diagnosis of grade C because one of the main criteria in grading is the bone loss/age score, which according to Graetz et al (2019)

bone loss/age is the main factor. associated with loss in the World Classification 2017 periodontitis classification system.[8,27]

Conclusions

There is significant difference of tooth loss by periodontitis stage IV between 1-3 months to 13-24 months recalls from baseline; grade A between 1-3 months to 13-24 months; grade C between 13-24 months to 1-3 months, 4-6 months, and 10-12 months recalls from baseline. In all, tooth loss due to periodontitis is differ based on stages and grades between recalls.

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Declaration of Interest

Authors have no conflict of interest regarding the study.

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