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ORIGINAL ARTICLE

Oral Hygiene and Dental Caries Status on Systemic Lupus Erythematosus Patients: A Cross-Sectional Study

Nanda Rachmad Putra Gofur[1], Kusworini Handono[2], Nurdiana Nurdiana[3], Handono Kalim[4], Wisnu Barlianto[5]

[1]Doctoral Program of Medical Science, Faculty of Medicine, Brawijaya University, Malang, Indonesia.
[2]Department of Clinical Pathology, Faculty of Medicine, Brawijaya University, Malang, Indonesia.
[3]Department of Pharmacology, Faculty of Medicine, Brawijaya University, Malang, Indonesia.
[4]Department of Internal Medicine, Faculty of Medicine, Brawijaya University, Malang, Indonesia.
[5]Department of Pediatric, Faculty of Medicine, Brawijaya University, Malang, Indonesia.

Author to whom correspondence should be addressed: Kusworini Handono, Department of Clinical Pathology, Faculty of Medicine, Brawijaya University, Malang, 65145, Indonesia. Phone: +628125296555. E-mail: dr.kusworini@gmail.com.

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Abstract

Objective: To evaluate the oral hygiene and dental caries status on Systemic Lupus Erythematosus (SLE) patients, also it's with SLE disease activity. **Material and Methods:** This is a descriptive study with a cross-sectional approach. The study was conducted on 93 SLE patients from 2017 to 2019 on Saiful Anwar Hospital Indonesia. All SLE patients had clinical examination using DMF-T, Personal Hygiene Performance-Modified (PHP-M), Calculus Index (CI), Debris Index (DI), Plaque Index (PI) and Simplified Oral Hygiene Index (OHI-S). Clinical examination and laboratory tests are conducted to assess the activity of SLE measured using. The data were analyzed by One Way ANOVA test. **Results:** A total of 74% of subjects with SLE had dental caries. PHP-M with SLE severity was found significant ($p<0.001$) and a strong positive correlation ($r=0.982$). Plaque with SLE severity was found significant ($p=0.001$) and a strong positive correlation ($r=0.938$). OHI-S with SLE severity was found significant ($p<0.001$) and a strong positive correlation ($r=0.953$). DMF-T levels with SLE severity was found significant ($p=0.001$) and a strong positive correlation ($r=0.974$). It showed that the severity of disease activity was related to poor oral hygiene and a high incidence of dental caries. **Conclusion:** There is a correlation between oral hygiene, dental caries and SLE severity.

Keywords: Autoimmune Diseases; Dental Plaque; Dental Health Surveys.

Introduction

Oral health is one thing that is quite important to concern. Research shows that dental health can affect body health and other organs such as heart, blood vessels, digestion, and lungs. Bacteria from the oral cavity could move through blood vessels to the brain and heart, causing infection. Vice versa, other diseases can also disrupt the health of the teeth to cause dental caries, poor oral hygiene, and missing teeth. One example is the presence of systemic diseases, such as diabetes and autoimmune. Autoimmune that rarely discussed associate with oral hygiene and dental caries is SLE [1,2].

Systemic Lupus Erythematous (SLE) is a chronic autoimmune disease that could attack various organs such as skin, kidney, musculoskeletal, nerve, cardiovascular, and oral health. Worldwide, activity in SLE patients worsened mortality in 40.9%, improved severity in 50.5% resulting in morbidity more than 64%. SLE in females had a higher incidence of SLE compared with males. The sex ratio ranged from 2:1 to 15:1. Incidence Asians with SLE was 16.7 per 100.000 people with the highest prevalence rate in the US, reported a prevalence of 241 per 100.000 people. There is evidence distribution of severity in SLE patients before, might be SLE known as a disease with a thousand faces [3].

B and T lymphocyte cells are responsible for the removal of receptors to ensure that autoreactive cells do not spread to the periphery. In SLE patients, dysregulation of the immune system causes hyperactivity of T cells and B cells and the formation of autoreactive cells. Autoreactive cells escape tolerance mechanisms and enter circulation. The presence of autoreactive B cells is illustrated by the discovery of autoantibodies in peripheral blood circulation [2,4].

Autoreactive B cells could produce Anti-double stranded DNA (anti-dsDNA). These autoantibodies will form immune complexes and are deposited in the tissues, causing chronic inflammation [4]. SLE patient is vulnerable to infection due to immune dysfunction. This condition could affect SLE severity, manifest in many organs, especially dental health. Poor dental health in SLE patients is found from high debris, calculus to high dental plaque. Poor dental health could cause an infection resulting in dental caries until missing teeth [5,6]. The manifestation of SLE in the oral cavity can be ulcerated lesions on the mucosa, cavities, and damage to periodontal tissue, periodontitis. Xerostomia is found 75%, ulcerated lesions 15-40%, cavities (33-60%) and periodontitis (60-93%) [7].

Poor dental plaque consists of bacteria and viruses. According to experts, plaque consists of 70% bacteria and 30% intercellular matrix material. Furthermore, within a few hours, an attachment occurs where the bacteria attach form into subgingival calculus containing bacteria-shaped rod and cocci [8,9]. Bacteria attached to the teeth are assisted by SLE immune dysfunction because of vulnerable to infection. Bacteria strongly influence plaque formation. Streptococcus is the first bacterial species to attach to the teeth and begin plaque formation. Some other species progressively infiltrate plaques and days after the growth. The most cariogenic microorganisms are Streptococcus groups. These organisms not only produce acids organic quickly from refined carbohydrates, but they also can produce a high acid atmosphere [10,11]. On the other hand, this acidogenic bacteria (*S. mutans* and *S. sobrinus*) and ammonia producing bacteria (*S. sanguinis* and *S. gordonii*). These four bacteria accumulated in SLE and could change the pH drop caused by organic acid produced [12].

Bacterial metabolism from refined carbohydrates with high levels on the plaque on the surface of the teeth can cause a decrease in pH of 2-4 points. The degree of decrease in pH depends on the thickness of the plaque, the number and combination of bacteria contained in plaque, as well as the efficiency of the ability of salivary buffer. SLE patients also had xerostomia conditions and could affect the efficiency of the ability of

salivary buffer [12-14]. This condition could affect dental health resulting in poor oral hygiene and a high number of dental caries.

This article aims to find dental health conditions on SLE patients, consist of oral hygiene and dental caries and its correlation with SLE disease activity.

Material and Methods

Study Design and Sample

The design of this study was a study with a cross-sectional approach. A total of 357 patients were evaluated, but 264 were excluded due to previously established criteria. The study held from September 2017 until October 2019 at Rheumatology Department, Saiful Anwar Hospital Malang, Indonesia.

Inclusion criteria were female subjects with a confirmed diagnosis of SLE, willing to become the subject of study, could read and write, and had full consciousness. Exclusion criteria were smoking, pregnancy, diabetes, B12 deficiency, and another systemic disease. All oral clinical evaluations were examined and calibrated with three expertise dentists, also for SLE patients were diagnosed, rheumatology supervisors.

Data Collection

All SLE patients had a clinical examination of the oral cavity to assess the presence of oral health using the index as Decay Missing Filling Teeth (DMF-T), Personal Hygiene Performance-Modified (PHP-M), Calculus Index (CI), Debris Index and Oral Hygiene Index (OHI-S) and Plaque Index (PI). Clinical examination and laboratory tests are conducted to assess the activity of the disease. The severity of SLE measured using the SLE Disease Activity Index (SLEDAI).

SLE Disease Activity Index (SLEDAI)

SLEDAI is an index for measuring disease activity in SLE patients. There are 24 items for the nine organs/systems. Scored if present within the last 10 days. Two systems can score a maximum of 8 points each, 2 systems can score a maximum of 4 points each, 3 systems can score a maximum of 2 points each, and 2 systems can score a maximum of 1 point each [15]. Scores range from 0–105 points. Recently, the SLEDAI for measure a timeframe of 30 days before a visit for clinical and laboratory [15,16].

Caries Prevalence Using DMFT Index

The dental caries status data was obtained by examination using the DMFT index on permanent teeth. D or decayed was carious teeth/ M (Missing) for revoked teeth due to caries, teeth extraction trace, or presence of root residue. F (Filling) for restored teeth by any restoration. Summation was done to obtain the results DMFT, and also to found out the DMFT average value. DMFT index criteria were categorized as very low in the value of 0.0-1.1; low in the value of 1.2-2.6; moderate in the value of 2.7-4.4; high in the value of 4.5–6.5; and very high in the value above 6.6 [12,17].

Personal Hygiene Performance-Modified (PHP-M)

PHP-M was used to examine plaque index on though the plaque index score is calculated through the total number of plaque scores the entire surface of the teeth examined was divided with the total number of examined tooth surfaces. Assisted with smearing is using a disclosing solution. Teeth examined by PHP-M method are right central incisor, upper left canine, upper left second premolar, incisor lower left central, lower

right canine, lower right second premolar if there was no plaque on the tooth surface, the value was 0, but if there is a plaque on the tooth surface, the value was 1. Plaque index of each person was calculated by the total value of all the subdivisions of dental plaque divided number of teeth examined. The level of clinical PHP-M can be categorized as follows 0.1-1.7 is good, 1.8-3.4 is fair and 3.5-5.0 is poor [18].

OHI-S Index

Recorded on the OHI-S examination is assessed to measuring the surface area of the teeth covered by food debris or calculus. Specific assessment criteria, namely Simplified Oral Hygiene Index (OHI-S). Inspection is on six teeth, namely teeth 16, 11, 26, 36, 31, and 46. Teeth 16, 11, 26, 31 is viewed on the buccal surface, whereas teeth 36 and 46 on the lingual surface. If one of the index teeth has been lost or the remaining roots remain, an assessment can be made on the representative replacement teeth. OHI-S is calculated from Debris Index (DI) + Calculus Index (CI) [19,20].

Debris Index (DI) and Calculus Index (CI)

Debris index by Greene and Vermillion is an examination carried out by examining the 6 teeth described above on OHI-S. The examination is done by placing a probe on 1/3 incisal or occlusal teeth and then moved towards 1/3 gingival [12,20].

Plaque Index

Plaque index assessment was done using the mouth mirror and probe after the teeth are dried. One of all teeth or only selected teeth can be used in the Plaque Index. The examination was carried out using six teeth as 16, 12, 24, 36, 32, and 44. Plaque Index assessment for each area is obtained by adding up the values of the four surfaces of each tooth. The number of Plaque Index values per area divided by four, and then obtained Plaque Index for teeth. While each person's Plaque Index value is obtained by adding up the Plaque Index value for each tooth then divided by the number of teeth examined [12,20].

Data Processing and Analysis

The collected data were analyzed using the SPSS software, version 20. The data were normalized using the Kolmogorov-Smirnoff. One Way ANOVA was also used for comparison test with post hoc Tukey and Spearman / Pearson for correlation test [21].

Ethical Considerations

The research received ethical approval from the UB Medical Ethics Committee from the Faculty of Medical, Brawijaya University Malang, East Java (Protocol No. 400/120/K.3/302/2017). All patients included in this study were required to sign an informed consent.

Results

A total of 93 SLE subjects were included in this study. SLE patients had average ages 30.54 ± 10.25 years and the SLEDAI score was 17.83 ± 11.02. We found that 69 patients (74%) subjects with SLE had decay teeth, 62 patients (66%) had missing teeth, 56 patients (60%) had filling teeth, 61 patients (65%) had plaque, 58 patients (62%) had debris and 55 patients (59%) had calculus.

Oral Hygiene, Dental Caries examination was performed in SLE subjects. Distribution frequency of oral hygiene, dental caries finding was showed in Table 1. Oral hygiene and dental caries in SLE patient was dominant with good PMP (40.8%), poor plaque (48.4%), good OHI-S (48.4%) and poor caries teeth (DMF-T).

Table 1. Dental health status on SLE patients.

Dental Health Status	N (%)	Mean (SD)
PHP-M		
Good	38 (40.8)	0.81 ± 0.60
Fair	27 (29.1)	2.83 ± 0.56
Poor	28 (30.1)	4.36 ± 0.35
Plaque Index		
Good	24 (25.8)	0.39 ± 0.31
Fair	24 (25.8)	1.72 ± 0.23
Poor	45 (48.4)	2.48 ± 0.22
OHI-S		
Good	45 (48.4)	0.57 ± 0.26
Fair	30 (32.2)	1.95 ± 0.59
Poor	18 (19.4)	4.08 ± 0.83
DMF-T		
Good	20 (21.6)	0.45 ± 0.51
Fair	26 (27.9)	2.96 ± 0.82
Poor	47 (50.5)	8.08 ± 3.98

Comparison of oral hygiene and dental caries status divided into three groups based on SLE severity. SLE subject with mild (n=15), moderate (n=19), and severe (n=59) were showed in Table 2. There was a significant difference ($p<0.05$) in oral hygiene and dental caries findings, including PHP-M, Plaque, OHI-S, and caries teeth using DMF-T between three groups. Dental Caries finding was obtained from DMF-T index with results 5.01. It means that high caries risk was found in SLE patients.

Table 2. Comparison of oral hygiene, dental caries based on SLE Severity.

Variables	Mild SLE	Moderate SLE	Severe SLE	p-value
PHP-M	0.19 ± 0.17	1.11 ± 0.35	3.48 ± 0.98	<0.001*
Plaque Index	0.20 ± 0.14	1.11 ± 0.43	2.34 ± 0.32	<0.001*
OHI-S	0.29 ± 0.10	0.59 ± 0.12	2.41 ± 1.33	<0.001*
DMF-T	0.26 ± 0.45	2.00 ± 0.74	7.18 ± 3.37	<0.001*

*ANOVA.

The correlation between oral hygiene and dental caries (based on PHP-M, Plaque Index, OHI-S, and DMF-T) with SLE severity was assessed using the Pearson correlation test and the results were shown in Figure 1. It can be seen that there was a significant and positive strong correlation between SLE severity using SLE Disease Activity with PHP-M, Plaque, OHI-S, and DMF-T. PHP-M with SLE severity was found significant ($p<0.001$) and a strong positive correlation ($r=0.982$). Plaque with SLE severity was found significant ($p=0.001$) and a strong positive correlation ($r=0.938$). OHI-S with SLE severity was found significant ($p<0.001$) and a strong positive correlation ($r=0.953$). DMF-T levels with SLE severity was found significant ($p=0.001$) and a strong positive correlation ($r=0.974$).

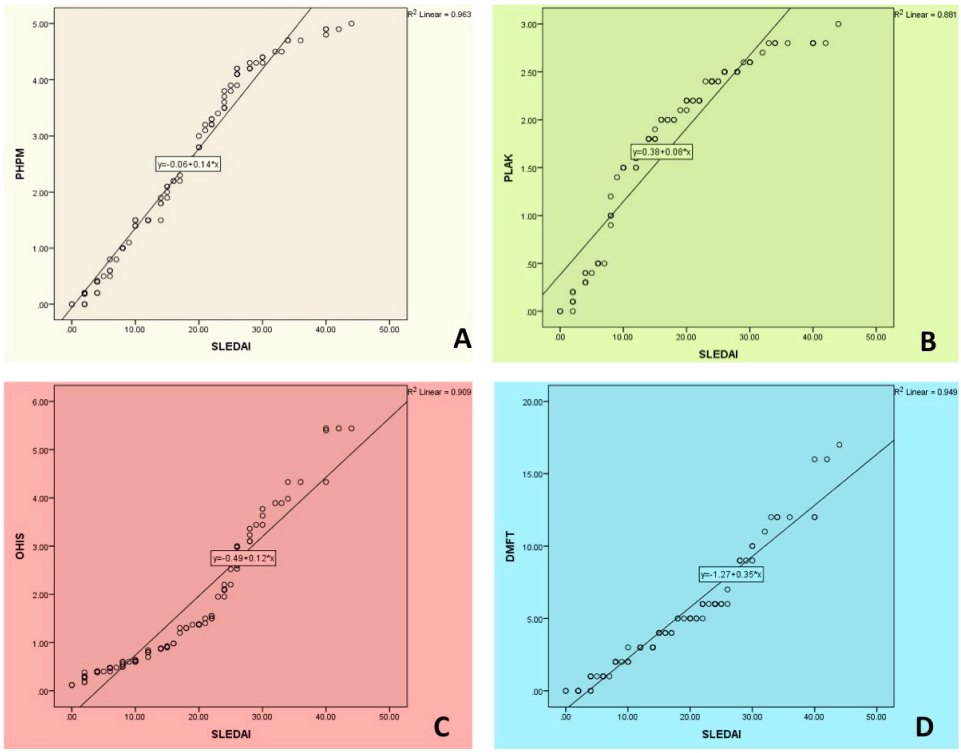

Figure 1. Correlation between Oral hygiene and dental caries and SLE Severity. PHP-M with SLE severity (A) and the correlation between Plaque with SLE severity (B). Correlation between OHI-S with SLE severity (C) and the correlation between DMF-T levels with SLE severity (D) in SLE patients.

Discussion

Recently, studies reported an association between poor dental health with Systemic Lupus Erythematosus (SLE) disease with a strong correlation (r<0.6). SLE patients had dental disease incidence reported 60-93% worldwide, higher than healthy patients with no systemic disease [7]. Oral manifestations have been found frequently in SLE patients, including recurrent infections or mouth ulcers, severe gingivitis, temporomandibular joint disorder, osteonecrosis of the mandible, hyposalivation (decrease of salivary flow), and excessive dental caries [12]. A previous study found poor oral hygiene as a result of abnormalities in immune response in SLE patients [6]. Autoantibodies are resulting in oral bacteria changing, and biofilm with virulence microbe forming, such as dominant *streptococcus mutants* and *porphyromonas gingivalis* finding [12]. Immune response abnormalities in SLE, hyperactivity of production of autoantibodies deposited in human tissue and organ could affect dental health condition. Higher SLE activity disease also resulting in poor oral hygiene due to immune response. Recent studies also found the activity of SLE had a strong positive correlation with infection, especially periodontitis [6,7,22,23].

Anti-dsDNA antibodies are specific autoantibodies against SLE and have a significant role in the SLE mechanism, as evidenced by the high levels of anti-dsDNA antibodies. Very low levels of anti-dsDNA is found in other autoimmune diseases and normal people. Anti-dsDNA antibodies are the result of a relationship between DNA and immunogenic proteins, which originate from apoptotic debris and apoptotic cell surfaces. A previous study found this autoantibody affects vulnerable in oral health and infection. Higher anti-ds-DNA was found before had a strong positive correlation with poor oral hygiene and periodontitis in SLE patients [6]. This autoantibody could be deposit to several organs, including dental and oral. This could affect organ damage, especially, resorption of bone and fibroblast damage [24].

A correlation of SLE within plaque index suggests that it is plaque-induced caries and poor oral hygiene, exacerbated by oral microbiota changes in SLE patients. A previous study also proves that correlation within autoimmune disease, especially SLE and plaque [7]. Plaque is accumulated food scrap and bacterial developing into calculus, the main causes of caries. High accumulated bacteria in plaque could explained 5.0 DMFT index in this study [25]. The clinical study carried out also confirmed that SLE patients are vulnerable to dental caries, as did by other independent studies carried out in other countries [26]. Also, there is a study that compared the activity of SLE that reported a DMFT index of 9.0 [22,27].

Long-term SLE diagnosis could be a significant issue in the severity of dental caries due to long-term damage of salivary glands. It could affect salivary flow and buffer capacity and could lead to oral microbiota changes [12,28]. However, further studies could explain the correlation between SLE diagnosis, age, drug intake, and dental caries with poor oral hygiene. However, previous authors found the association between SLEDAI activity and severity of dental caries due to salivary dysfunction such as reduction of salivary flow and decrement of saliva pH [29,30].

Poor oral hygiene also explained that OHI-S measured prediction of dental caries in SLE patients. Poor oral hygiene was caused by decreased saliva production and change in microbiota [30]. The study found that *Streptococcus mutans* and *Streptococcus sobrinus* species were enriched in SLE patients' salivary microbiome, while a decrease in salivary flow rate, pH, and buffer capacity was observed compared to healthy subjects. However, dental plaque is a sign that many microbial disease presences in oral cavity [12,31,32]. Moreover, the next study needs to describe salivary flow, pH rate, and also microbiological aspect.

Previous study found OHI-S status correlated with autoimmune patients. Previous research found that 88.1% of the sample had cavities, while 64.3% had missing teeth, but no significant difference between SLE patients diagnosed below 8 years and above 8 years [26]. It reported rate reaching 100% among those with SLE active disease. Higher cavities in dental health could affect higher missing teeth and decrease in quality of life. The present suggestion is salivary flow and saliva pH had a key role in the high caries activity of SLE patients. It is changing due to autoimmune responses, including systemic immune and also local immune conditions [33-35]. Furthermore, studies are necessary to reveal through which immune pathways SLE plays its influence through local and systemic tissue, also microbial composition to support this study. Other than that, this study revealed the presence of poor oral hygiene and a high incidence of dental caries as manifestations in SLE patients. Dentists should aware also pay attention and working SLE cases together with rheumatologists and other specialists.

Conclusion

This study confirmed that SLE patients were more vulnerable to caries infection. There is a correlation between oral hygiene, dental caries, and SLE severity. The poor plaque control, poor oral hygiene, and a high prevalence of dental caries are important aspects.

Authors' Contributions

NRPG	0000-0002-3662-4814	Investigation, Formal Analysis and Writing – Original Draft Preparation.
KH	0000-0002-4899-2454	Methodology and Writing – Review and Editing.
NN	0000-0001-5951-2607	Conceptualization, Methodology, Investigation and Writing – Review and Editing.
HK	0000-0002-3827-5275	Methodology and Writing – Review and Editing.
WB	0000-0001-6566-5335	Conceptualization, Methodology, Investigation and Writing – Review and Editing.

All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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Conflict of Interest

The authors declare no conflicts of interest.

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