Original Paper

Periodontitis Burden in Diffuse Versus Limited Systemic Sclerosis Subtypes: A Pilot Study

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ABSTRACT: Introduction. This study aimed to evaluate the periodontal status of a group of Romanian systemic sclerosis (SSc) patients and to investigate the relationships between periodontitis and SSc subtypes. Materials and methods. This observational study included patients diagnosed with limited SSc (lcSSc) and diffuse SSc (dcSSc). Demographic data were collected from medical records. Each participant underwent a full-mouth periodontal examination including Bleeding on Probing (BoP) index, Oral Hygiene (OH) index, Probing Depth (PD), Gingival Recession (GR), and Clinical Attachment Loss (CAL). The periodontal status was defined according to presently recognised case definition system. Results. The study included 30 patients with lcSSc and 30 patients with dcSSc with a mean age of 52.45±11.75 years. The overall periodontitis frequence in our SSc group was 95%. The frequency of stage III/IV periodontitis was higher in the dcSSc group (90%) than in the lcSSc group (60%). Within the group of SSc patients, significant positive correlations were observed between age, BoP index, OH index, the number of missing teeth, mean PD, mean CAL on one side and periodontitis diagnosis on the other side (r=0.588, p=0.001; r=0.399, p=0.002; r=0.388, p=0.002; r=0.574, p=0.001; r=0.444, p=0.001; r=0.571, p=0.001). A significant positive correlation existed between the diagnostic of periodontitis and SSc subtypes (r=0.327, p <0.001). Conclusions. Periodontitis was highly prevalent in both lcSSc and dcSSc groups. More stage III/IV periodontitis cases were detected dcSSc group of patients.

KEYWORDS: *Periodontitis; Systemic sclerosis; Inflammation; Pocket depth.*

Introduction

Periodontitis is a chronic inflammatory disease in which progressive periodontal destruction may induce tooth loss and alters the functions of the dental-maxillary apparatus and the quality of life [1].

Periodontitis is a highly prevalent disease in both developed and developing countries affecting up to 50% of adults in its mildest forms and rising to higher percentages in people aged >60 years [2].

The primary etiological factor of periodontitis is the microbial plaque triggering a host-mediated inflammatory immune response and behavioral and systemic risk factors [1].

Multiple studies demonstrated a strong association between periodontitis and several conditions such as diabetes, pregnancy complications, and cardiovascular diseases [3-5].

More recently, other diseases, including metabolic diseases, cancers, and autoimmune diseases such as systemic sclerosis (SSc), have been related to periodontitis [6].

SSc or scleroderma is a rare autoimmune connective tissue disorder with an unknown etiology and different grades of severity. SSc is characterized by progressive tissue fibrosis, vascular injury, and autoimmune destruction [7].

The 1980 classification of SSc was based on the skin involvement and described the limited SSc subtype (lcSSc) characterized by hand and face tissue fibrosis, and the diffuse SSc subtype (dcSSc), which determines upper and lower limbs skin fibrosis [8].

In 2013 new criteria were added to the classification to improve early diagnosis of SSc.

The skin thickening of the fingers extending proximal to the metacarpophalangeal joints was considered a sufficient predictor for SSc diagnosis.

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Additionally, to this diagnosis criterion, other characteristics such as telangiectasia, abnormal nail fold capillaries, Raynaud's phenomenon, and autoantibodies related to SSc should be applied [9].

Regarding the incidence of SSc, the studies reported ranges from 0.6/100.000 individuals in Norway from 1999-2009 [10] to 2.3/100.000 individuals in Spain from 1988-2006 [11].

In the same study developed in Spain is mentioned that the incidence rate considering gender and age differences was higher in women (1.8/100.000) compared to men (0.7/100.000) and significantly increased in individuals aged >45 years (3.1/100.000) compared to individuals aged <45 years (0.7/100.000) [11].

SSc has a major impact on oral health, causing significant extra-and intraoral changes such as microstomia, xerostomia, telangiectasia, tooth decay, bone resorption, and periodontitis [12].

Face skin fibrosis determines changes in personal appearances, such as the atrophy of the alar cartilage, thinning of the lips, disappearance of perioral furrows, and eye and forehead wrinkles resulting in expressionless "mask-like" facies [13].

Microstomia consecutive to fibrosis considerably reduces the functions of the maxillary apparatus, especially chewing, also impairs the oral hygiene routine and challenges dental treatments [14].

In recent years, the literature has described associations between periodontitis and SSc. Regarding the two subtypes of SSc, data suggested increased values of CAL (Clinical Attachment Loss) for the dcSSc subtype compared to lcSSc [15].

However, there are inconsistent reports on this issue.

Moreover, the real burden of periodontitis in SSc patients is not well established and to our knowledge there are no national reports on periodontal status in SSc patients.

The present study aimed to assess the periodontal status of a Romanian SSc patients group and to investigate the potential relationship between periodontitis and SSc subtypes.

Materials and Methods

Study design and participants

An observational study including patients diagnosed with SSc was carried out at the Rheumatology Department of County Emergency Hospital, Cluj-Napoca, after receiving ethical approval from the „Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca (No. 96/09.03.2020) and Regional Emergency Hospital (No.1098/15.01.2020).

Each participant received written informed consent before they underwent a full-mouth clinical periodontal examination.

The study was developed according to the regulations in the Declaration of Helsinki regarding the experiments on human subjects.

Patients diagnosed with SSc according to the 2013 American College of Rheumatology (ACR) and the European Alliance of Associations for Rheumatology (EULAR) classification were divided into two groups according to the SSc subtype (limited-lcSSc or diffuse-dcSSc).

The full-mouth periodontal examination was performed in hospitalization conditions with the consecutive completion of a periodontal chart.

Sociodemographic data were collected from medical charts between January 2020 and November 2022.

Inclusion and exclusion criteria

Subjects included in this study were patients aged ≥18 years, able to provide informed consent, who fulfilled the ACR/EULAR 2013 classification criteria for SSc diagnosis.

The exclusion criteria referred to underaged patients (<18 years), severe forms of SSc with the impossibility to examine the patients due to their poor medical status, any medical condition that required antibiotic treatment within the last three months, human immunodeficiency virus (HIV) infection, and patients with less than four remaining teeth.

Sociodemographic and medical history data collection

Demographic and medical history data were collected prior to the clinical periodontal examination.

All participants were asked to complete a questionnaire consisting of a set of survey questions resembling demographic information: age, gender (male, female), the highest level of education (1=primary school and gymnasium, 2=high school, 3=academic degree), employment status (1=unemployd, 2=ill-health retirement, 3=age retirement).

Social history was recorded by asking questions about smoking status and alcohol consumption.

Smoking status was divided into three categories: non-smokers (participants who have

never smoked and those who quit smoking more than one year ago), current smokers, and former smokers (who quit smoking at least six months before).

Periodontal examination protocol

The full-mouth periodontal examination of SSc patients was performed by previously calibrated examiners (S.A., A.C., I.C.M., A.S) supervised by a senior periodontologist (A.R.).

SSc patients underwent a full-mouth periodontal examination, excluding the third molars with standard methodology in natural light (hospitalization conditions) and equipment consisting in an intraoral mirror and an UNC-15 periodontal probe (Hu-Friedy, Chicago, IL, USA).

The measurement included the recording of periodontal parameters, probing depth (PD), gingival recession (GR), and clinical attachment loss (CAL) at six sites per tooth.

The values were rounded up to the nearest millimeter.

Gingival inflammation was evaluated through bleeding on probing index (BoP) calculated as a percentage of all positive sites per total number of examined sites [16].

Oral hygiene status was rated using the Oral Hygiene Index (OH) calculated identically as BoP [17].

Periodontitis Case Definition

Periodontitis was diagnosed based on the new classification proposed at the 2018 European Federation of Periodontology/ American Academy of Periodontology (EFP/AAP) [18] by applying the following criteria: the inter-dental CAL>0 of periodontal origin at two or more non-adjacent teeth, or the buccal or oral CAL ≥3mm plus pocketing >3mm.

Accordingly, the CAL of the site with the most severe periodontitis was recorded for each tooth. Cases presenting a CAL=1-2mm was defined as Stage I, CAL=3-4mm as Stage II, and CAL≥5mm as Stages III-IV.

Stage IV periodontitis was differentiated from stage III taking into account the complexity factors such as severe drifting, flaring, and severe mobility [19].

Statistical analysis

Data analysis was carried out using Statistical Package for Social Sciences (SPSS Software, Version version 20.0; IBM Corporation, Armonik, NY, USA) to assess the correlation between variables and SSc subtypes.

Student *t*-test was used after classifying patients according to the 2018 EFP/AAP classification (stage I, II, III and, IV) for studying the association between the group variables considering lcSSc and dcSSc subtypes.

Statistical significance was considered for *p*-value of ≤0.05.

The qualitative data (frequency distribution) and the quantitative data derived from periodontal and SSc parameters were assessed using statistical indices of variability and central tendency (range, minimum, maximum, ±standard deviation SD) in Microsoft Office Excel.

The frequency of periodontitis was calculated for both SSc subtypes as the sum of the four severity entities reported to the total number of subjects and expressed as a percentage value.

Results

A total of 71 participants with age ranging between 21 and 77 years were recruited for this study. Of the entire group, 60 patients, 52 females and 8 males fulfilled the inclusion criteria and were selected in the study (Figure 1).

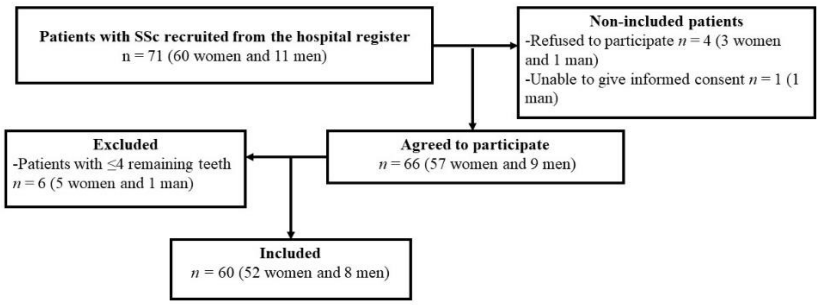

Figure 1. Flow chart of patients selected in the study.

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Demographic and behavior data of SSc patients included in the study

The sixty individuals diagnosed with SSc included in the current study had a mean (SD) age of 52.45±11.75 years.

More than half of the investigated individuals were females (*n*=52; 86.6%).

Regarding the level of education, 50% of patients graduated high school, and almost 20% had an academic degree.

The employment status revealed that 50% of the patients were in ill-health retirement.

Other information is provided by Table 1.

Table 1. Sociodemographic data of SSc group.

Variable	Categories	n	%
Age	≤45 years	17	28.3
	>45-<65 years	33	19.8
	≥65 years	10	16.6
Gender	Female	52	86.6
	Male	8	13.3
Level of education	Primary school and gymnasium	16	26.6
	High school	30	50.0
	Academic degree	12	20.0
Employment status	Unemployed	4	6.6
	Employed	17	28.3
	Ill-health retirement	30	50.0
	Age retirement	9	15.0
Environment	Urban	31	48.3
	Rural	29	51.6
Smoking status	Non-smoker	45	45.5
	Smoker	6	10.0
	Former smoker	26	44.4

Periodontal status in lcSSc and dcSSc patients

From the study group, 30 patients were diagnosed with lcSScs and 30 patients with dcSSc.

The periodontal conditions in both SSc groups are provided by Table 2.

Patients with dcSSc exhibited more severe periodontitis than patients with lcSSc.

The frequency of stage III/IV periodontitis was 90% in the dcSSc group and 60% in the lcSSc group. CAL ≥5mm in at least 2 sites was observed in 16 participants from the lcSSc subtype and 26 participants from the dcSSc subtype (Table 2).

The mean values of BoP for lcSSc and dcSSc patients were 26.33% (±21.93) and 28.50% (±23.69), respectively.

The mean OH values of lcSSc and dcSSc groups were 34.50% (±29.14) and 54.60% (±27.24), respectively.

The differences between mean values of lcSSc CAL and dcSSc CAL were not statistically significant (Table 2).

Table 2. Periodontal status according to lcSSc and dcSSc subtypes (total number and percentage). Abbreviations: CAL=clinical attachment loss; SSc=systemic sclerosis, lcSSc=limited SSc, dcSSc=diffuse SSc; SD=standard deviation.

SSc subtype	Non-perio *n*=3	Stage I *n*=1	Stage II *n*=11	Stage III *n*=12	Stage IV *n*=33	Mean CAL (±SD)
lcSSc	3 (10%)	1 (3.33%)	8 (26.6%)	6 (20%)	12 (40%)	2.144 (±2.147)
dcSSc	0 (0%)	0 (0%)	3 (10%)	6 (20%)	21 (70%)	2.549 (±1.859)

Within the group of SSc patients, significant positive correlations were observed between age, BoP index, OH index, the number of missing teeth, mean PD, mean CAL on one side and periodontitis diagnosis on the other side (r=0.588, p=0.001; r=0.399, p=0.002; r=0.388, p=0.002; r=0.574, p=0.001; r=0.444, p=0.001; r=0.571, p=0.001).

A significant positive correlation existed between the diagnostic of periodontitis and SSc subtypes (r=0.327, p <0.001), which means that more frequent periodontitis cases were included in dcSSc group than in lsSSc group.

Significant negative correlations were found between environment, smoking status and SSc subtype (Table 3).

Table 3. Correlations between periodontitis parameters, sociodemographic data, and SSc subtypes. Abbreviations: SSc=systemic sclerosis; BoP=Bleeding on Probing; OH=Oral Hygiene; PD=Probing Depth; CAL=Clinical Attachment Loss; r=Pearson correlation; p=p-value.

		SSc subtype	Age	Environment	Smoking status	BoP Index	OH Index	Periodontal diagnosis	Absent teeth	Mean PD	Mean CAL
SSc subtype	*r*		-0.110	**-.367****	**-.294***	0.048	0.179	**.327***	-0.026	-0.209	-0.035
	p		0.402	**0.004**	**0.023**	0.715	0.171	**0.001**	0.843	0.109	0.791
Age	*r*	-0.110		0.072	-0.024	0.051	0.229	**.588****	**.617****	**.362****	**.399****
	p	0.402		0.586	0.858	0.698	0.079	**0.000**	**0.001**	**0.004**	**0.002**
Environment	*r*	**-.367****	0.072		0.085	-0.128	-0.164	-0.211	-0.069	0.082	-0.119
	p	**0.004**	0.586		0.518	0.332	0.209	0.105	0.601	0.532	0.367
Smoking status	*r*	**-.294***	-0.024	0.085		0.156	0.102	-0.079	0.157	**.369****	**.287***
	p	**0.023**	0.858	0.518		0.233	0.439	0.550	0.230	**0.004**	**0.026**
BoP Index	*r*	0.048	0.051	-0.128	0.156		**.519****	**.399****	0.241	**.362****	**.476****
	p	0.715	0.698	0.332	0.233		**0.001**	**0.002**	0.064	**0.004**	**0.001**
OH Index	*r*	0.179	0.229	-0.164	0.102	**.519****		**.388****	0.249	**.338****	**.427****
	p	0.171	0.079	0.209	0.439	**0.001**		**0.002**	0.056	**0.008**	**0.001**
Periodontal diagnosis	*r*	**.327***	**.588****	-0.211	-0.079	**.399****	**.388****		**.574****	**.444****	**.571****
	p	**0.001**	**0.001**	0.105	0.550	**0.002**	**0.002**		**0.001**	**0.001**	**0.001**
Absent teeth	*r*	-0.026	**.617****	-0.069	0.157	0.241	0.249	**.574****		**.382****	**.523****
	p	0.843	**0.001**	0.601	0.230	0.064	0.056	**0.001**		**0.003**	**0.001**
Mean PD	r	-0.209	**.362****	0.082	**.369****	**.362****	**.338****	**.444****	**.382****		**.683****
	p	0.109	**0.004**	0.532	**0.004**	**0.004**	**0.008**	**0.001**	**0.003**		**0.001**
Mean CAL	r	-0.035	**.399****	-0.119	**.287***	**.476****	**.427****	**.571****	**.523****	**.683****	
	p	0.791	**0.002**	0.367	**0.026**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Discussion

This study evaluated the periodontal status of a group of Romanian SSc patients and showed precarious periodontal conditions in both lcSSc and dcSSc with an increased stage III/IV periodontitis burden of 60% and 90%, respectively.

This finding sustains the previous data reported by the literature reporting increased BoP [20], as well as PD and CAL values in SSc patients as compared with the control patients [15,20-25].

Moreover, more teeth with PD >3mm and CAL ≥5mm were found in SSc patients compared to controls [21,22].

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To our knowledge, the previous studies assessed the associations between periodontitis and SSc without using a specific case definition of periodontitis or applying older versions of case definition systems [15,20,21,25].

Also, this study found a correlation between SSc subtypes and periodontitis burden.

Moreover, more severe periodontal destructions (stage III/IV periodontitis) were found in dcSSc group than in lcSSc group, which is in agreement with previous data reporting more severe periodontal conditions in terms of CAL values in dcSSc than in lcSSc [15].

Differences in inflammation levels and immunity disbalances could partially explain the findings mentioned above.

Other significant correlations were obtained between periodontitis and periodontal parameters (PD, CAL, BoP, OH, number of missing teeth) as expected.

Furthermore, no associations between periodontitis and smoking status were found.

One explanation for the lacking correlation between smoking and periodontitis may be that this study cohort was relatively small, with a low number of active smokers and an increased number of former smokers (about 44%) which may bias the results as smoking influences the progression of periodontitis [26].

Despite the increased frequency of periodontitis in both groups and a high proportion of severe periodontal destruction in SSc patients, the level of inflammation expressed by the BoP index was relatively low, with a mean value of approximately 27%.

A reduced value of the BoP index was reported in other studies possibly due to capillary loss and marked fibrosis [27,28].

Increased OH index in both SSc groups could partially explain the poor periodontal conditions of SSc patients and could be the consequence of fibrosis-induced microstomia, which impairs oral hygiene and favors dental plaque accumulation-the essential premise for periodontitis initation and development.

The literature suggests improving self-performed oral hygiene in SSc patients based on tailored prophylactic programs and adapted oral hygiene devices such as powered toothbrushes [29].

Microstomia also prevents dental treatments, which augment oral problems and negatively impact the quality of life of SSc patients.

The screening of periodontal status should be assessed in all SSc patients, as timely treatment can prevent damage and tooth loss.

The present study has strengths and limitations.

The strengths of this study refer to the periodontal examination of SSc patients using a gold-standard full-mouth approach associated with a six-site-per-tooth evaluation, as well as the assessment of reference parameters by calibrated operators.

The most accurate parameter for tracking the progression of periodontal disease is CAL, which is also a reliable diagnostic marker that accurately assesses the degree of periodontal tissue destruction in relation to a stable reference point the cementoenamel junction [30,31].

Moreover, the estimation of periodontitis burden was based on the new 2018 EFP/AAP case definition system that would facilitate future comparisons with the results provided by other studies with similar design and the elaboration of preventive measures.

An additional strength point is the cohort is the use of ACR/EULAR criteria to define the SSc cases.

A limitation of this study is the relatively small size of the cohort.

In consequence, our results should be interpreted cautiosly.

Therefore, additional research on the relationship between SSc and periodontitis is necessary with larger sample size and a prospective design.

Conclusions

Based on actual 2018 EFP/AAP case definition system, our study highlights an increased periodontitis frequency in the Romanian SSc group.

Moreover, the dcSSc group had more precariuos periodontal conditions and a higher severity of periodontitis (stage III/IV) as compared with lcSSc group.

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Alina Stanomir and Iulia Cristina Micu, equally contributed to this study and thus share first authorship.

Conflict of interests

None to declare.

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