Case Series

# Periodontal Microcirculatory Abnormalities in Patients With Systemic Sclerosis

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***Background:*** *The aim of this study was to observe the differences in periodontal microcirculation between healthy patients and patients with systemic sclerosis (SSc).*

***Methods:*** *Fifteen healthy patients and 15 patients with SSc were examined. Periodontal capillaroscopy was used to investigate the characteristics of microcirculation. The visibility, course, tortuosity, possible presence of microhemorrhages, average caliber of the capillary loops, and number of visible capillary loops per square millimeter were evaluated for each patient.*

***Results:*** *The investigation was simple, non-invasive, and repeatable for each patient. In patients with SSc, it was possible to observe a reduced number of capillaries and a greater capillary diameter and tortuosity.*

***Conclusions:*** *Capillary alterations in patients with SSc are not limited to the nailfold bed but also occur in periodontal mucosa microcirculation. Such evidence could be extremely important in the pathogenesis and treatment of periodontal diseases in patients with SSc.* J Periodontol 2005;76:1991-1995.

**KEY WORDS**

**Capillaroscopy; mucosa; systemic sclerosis.**

Capillaroscopy is a non-invasive diagnostic technique, fundamental in viewing peripheral circulation and in studying microangiopathies, which are the manifestations of numerous pathologies in both the diagnostic and monitoring phases of the disease.[1,2]

The alterations in the capillaroscopic picture can represent, in fact, the only documentary evidence of an incipient disease. Compared to other pathologies, in which microangiopathies exclusively represent a complication (e.g., diabetes mellitus), some collagenopathies may show microcirculation alterations even in clinically healthy areas; these alterations have been documented by histologic examinations in the early stages of such disease.[3-5]

Because capillaroscopy is non-invasive, inexpensive, easily repeatable, and comparable even after years, it permits the monitoring in time of any disease compromising microcirculation.[6-13]

The aim of this study was to observe the periodontal microcirculation in patients with SSc and to evaluate whether microcirculation alterations may play a part in the pathogenesis of periodontal disease in these patients.

## MATERIALS AND METHODS

Fifteen healthy patients (three men and 12 women; mean ± SD age: 61.23 ± 4.4 years; range: 38 to 79 years) and 15 patients with SSc (three men and 12 women; mean ± SD age: 61.89 ± 7.7 years; range: 35 to 72 years) were examined in our laboratory from January to October 2004; their demographic characteristics are summarized in Table 1.

The healthy patients were included in the study only if an accurate exam of their medical history revealed that they were non-smokers. The Löe and Silness gingival index[14] and the plaque index were equal to 0 in the study area for all the subjects under study.

All of the patients gave their informed consent for the processing and use of their personal medical data in scientific papers, according to Italian law. The study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2000.

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**Table 1.**

## Demographic Characteristics of Patients

| | Healthy Patients (N = 15) | Scleroderma Patients (N = 15) | Significance* |
|---|---|---|---|
| Male/female ratio | 3/12 | 3/12 | |
| Age (mean ± SD) | 61.23 ± 4.4 years | 61.8 ± 7.7 years | NS |
| Range (years) | 38 to 79 | 35 to 72 | |

* The differences between healthy and scleroderma patients were tested using Mann-Whitney U test.
NS = not statistically significant ($P > 0.01$).

All of the patients with systemic sclerosis fulfilled the diagnostic criteria for scleroderma.[15] All of the SSc patients were classified as having limited cutaneous sclerosis (skin involvement limited to hands, forearms, and face) according to the guidelines of Le Roy et al.[16] They were examined using computerized videomicroscopic techniques and related software.[5,12] The optical probe videomicroscope is composed of a main unit, to which an optical probe with a video-optical terminal is connected, and by a high resolution color monitor to view the examined area. The main unit consists of a cold-halogen light source emitted by a 100 W lamp provided with an electronic device that controls light intensity and a processing unit for the high definition video signal (420,000 pixels) provided with a color calibration device. The probe is equipped with a video-optical terminal containing a high definition video sensor, on which different variable magnification optics from 10× to 1000× can be applied. A technological characteristic of the video-optical terminal is the possibility to focus directly from the handpiece.[17,18]

Image digitization allows for the analysis of the fundamental parameters of microcirculation (caliber and vessel length) and the calculation of the number of capillaries per millimeters$^2$ of the mucosa examined.

The capillaroscopic investigation was carried out with the patients in a sitting position, with the same light source and room temperature (23°C), in the morning, by the same operator, and repeated twice for each examined area.

The examined area was always the same for each patient: the interdental papilla corresponding to maxillary central incisors.

Two independent observers examined all the images. The intraobserver and interobserver variability was assessed with the two observers evaluating twice the same randomly selected images. The following static parameters were used: A) non-parametric data: capillary loop visibility (marks from 1 to 4): 1) simple focusing, within 30 seconds from the beginning of the examination; 2) average focusing, over 30 seconds and within 2 minutes; 3) difficult focusing, over 2 minutes; and 4) impossible focusing; orientation regarding the surface (marks A, B, or AB): A) capillary loop course parallel to the surface; B) capillary loop course perpendicular to the surface; and AB) both parallel and perpendicular; capillary tortuosity (marks from 0 to 3): 0) absence of crossing in the capillary loops; 1) presence of crossing; 2) greater presence of crossing; and 3) complete distortion of the capillary loops; microhemorrhages (marks 0 or 1): 0) absence; and 1) presence; characteristics of the capillary loops (marks 0 or 1): 0) absence; and 1) presence. B) Parametric data: number of visible capillary loops per square millimeter (value obtained from the average of the two observations for each examined area); and capillary loop caliber (values obtained from the average of the two observations for each examined area).

As regards the parametric data, it must be emphasized that they originate from the software connected to the videocapillaroscope. The system is specifically calibrated so that every optical magnification corresponds to an exact metric pixel value in the digitalized image; therefore, the capillary caliber can be measured with a high degree of precision.

All of the patients involved in the study kept a dietary diary for a period of 3 months to evaluate any dietary differences that could affect the periodontal capillary pattern observed.

The statistical significance of the differences between the healthy and the SSc patients was checked with the Student's *t* test for independent samples with regard to parametric data and with the Mann-Whitney U test (MW test) with regard to non-parametric data. The level of significance was set to $P < 0.05$. Data analysis was carried out.†

The results obtained from each examined area represent the average values of the two observations.

## RESULTS

Intrasubject variability satisfied the *a priori* hypothesis of limited dispersion. For the parametric data, variability ranged from +2% to –2% with respect to the mean value. For the non-parametric data, a mark difference of 1 was observed at most.

No significant differences relating to age were detected between the healthy and the scleroderma patients ($P > 0.01$; MW test).

Microcirculation visibility was clear in the patients and in the control.

† StatView 5.0.1, SAS Institute, Cary, NC.

Microcirculation architecture in the healthy and in the SSc patients was characterized by a network of capillaries in polygonal mesh with parallel orientation (type A) as regards the surface.

Capillary tortuosity in the healthy patients obtained a mark of 0 in eight patients, 1 in two patients, 2 in three patients, 3 in two patients. In the SSc patients, capillary tortuosity was 0 in four patients, 1 in two patients, 2 in two patients, and 3 in seven patients ($P<0.001$). Rare microhemorrhages (mark 1) were observed in six healthy patients. These were identified as reddish stains, possibly caused by microtraumas. No microhemorrhages were observed in the SSc patients.

The caliber of the visible capillary loops was 14.92 ± 2.3 μm (mean ± SD) in the healthy patients and 20.7 ± 2.5 μm (mean ± SD) in the SSc patients ($P<0.001$; MW test). The number of visible capillaries was 7.87 ± 1.92 (mean ± SD) in the healthy patients and 4.1 ± 1.8 (mean ± SD) in the SSc patients ($P<0.001$; MW test) (Figs.1 through 3).

No significant differences in the dietary habits of the patients were detected.

The results of the observations of the periodontal mucosa are summarized in Table 2.

## DISCUSSION

Capillaroscopy is a very stimulating method for studying microcirculation because of the possibility of studying small vessels in vivo by means of a microscope. Today, capillaroscopy is becoming more reliable because of the improvement of the observation tools (photography and videomicroscopy).[8-13,19-21]

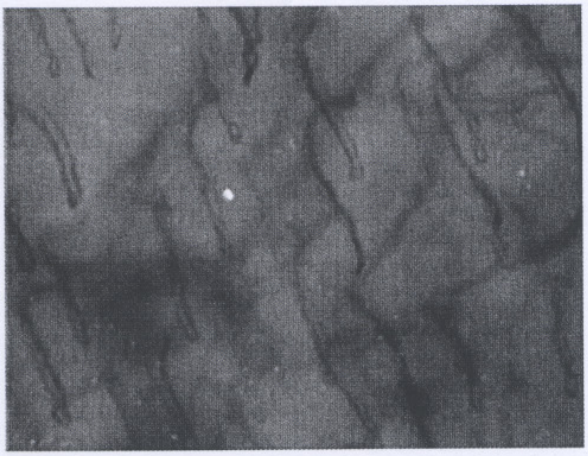

***Figure 1.***
*Microcirculation characteristics close to the interdental papilla corresponding to maxillary central incisors in healthy patients (original magnification ×200).*

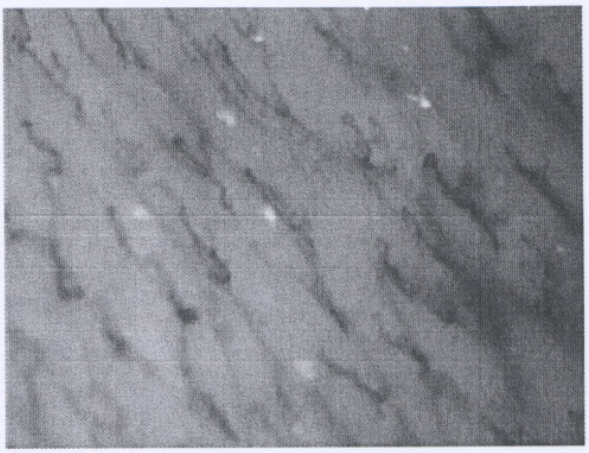

***Figure 2.***
*Microcirculation characteristics close to the interdental papilla corresponding to maxillary central incisors in SSc patients (original magnification ×200).*

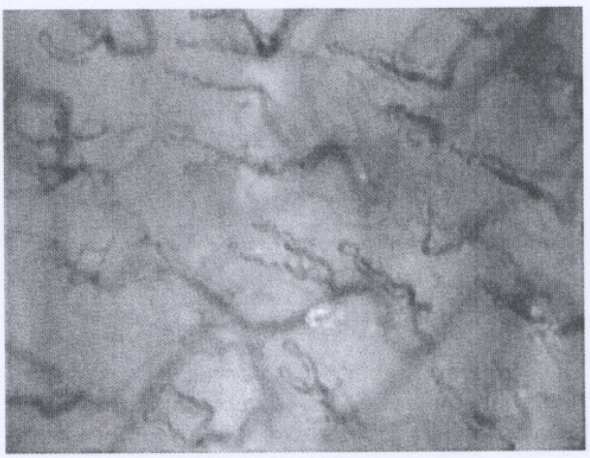

***Figure 3.***
*Microcirculation characteristics close to the interdental papilla corresponding to maxillary central incisors in SSc patients (original magnification ×200).*

The morphological study of microcirculation is of fundamental importance; in fact, the microvascular bed is directly involved both in autoimmune etiopathogenetic pathologies and in acute and chronic inflammatory etiopathogenetic pathologies.[22,23]

The value of capillaroscopic investigation as a diagnostic means for peripheral microcirculation damage is confirmed by numerous studies. With the use of this method, Halfoun et al.[4] showed that diabetic patients have capillary flow regulation abnormalities. With the same investigation technique, Haak et al.[3] showed that, in diabetic patients, the nervous

**Table 2.**

**Characteristics of Periodontal Mucosa Microcirculation in Healthy and SSc Patients**

| | Healthy Patients | SSc Patients |
|---|---|---|
| Visibility of the capillary loops (mark, % patients) | 1, 89% | 1, 90% |
| | 2, 7% | 2, 10% |
| | 3, 4% | |
| | 4, 0% | |
| Orientation with regard to the surface (mark, % patients) | A, 100% | A, 100% |
| Tortuosity (mark, N patients) | 0, 8 | 0, 4 |
| | 1, 2 | 1, 2 |
| | 2, 3 | 2, 2 |
| | 3, 2 | 3, 7 |
| Microhemorrhages (mark, N patients) | 1, 6 | 0, 15 |
| Caliber of the capillary loops (mean ± SD)*† | 14.92 ± 2.3 μm | 20.7 ± 2.5 μm |
| N visible capillaries/mm$^2$ (mean ± SD)*† | 7.87 ± 1.92 | 4.1 ± 1.8 |

* The differences between healthy and scleroderma patients were tested using Mann-Whitney U test.
† Statistically significant ($P$ <0.001).

reflex arcs are impaired. However, it must be said that other studies have used capillaroscopic investigation to evaluate microcirculation damage not as a complication of a disease (e.g., diabetes) but as its beginning and, therefore, to make a diagnosis (i.e., SSc).[17,22,24,25]

Prominent SSc vascular abnormalities are noted in capillaries and small blood vessels. The affected capillaries are characterized by distorted and irregular loops. The changes include a reduced number of capillaries and the presence of desertification. The appearance of considerably large capillaries and hemorrhages is of great importance for the early diagnosis of SSc. The nailfold observation of capillary loss and vascular architectural disorganization represents the clearest aspect of advanced microvascular damage caused by SSc.

At the ultrastructural level, the earliest changes consist of large gaps among the endothelial cells, vacuolization of the endothelial cytoplasm, an increase in the number of basal lamina-like layers, and disruption of the endothelial cell cytoplasmic membranes.

Our study shows that capillaroscopy is a reliable method in the observation of periodontal microcirculation.[7,20] Thus, capillaroscopic alterations in the presence of SSc are not exclusively limited to the nailfold bed but result even in the peripheral circulation of the periodontal mucosa. Periodontal capillaroscopy in SSc patients revealed significant microvascular changes compared to the control.

The periodontal capillaroscopic pattern is recognizable through a direct evaluation and is characterized by a reduced number of capillaries and a greater capillary diameter and tortuosity.

This study was aimed at accumulating evidence suggesting that microvascular periodontal alterations may play a crucial part in the complex activity associated with periodontal disease in SSc patients.

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