

ORIGINAL PAPERS

Dent. Med. Probl. 2004, 41, 3, 449–453
ISSN 1644-387X

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Panoramic Periodontal Capillaroscopy – a New Diagnostic Method

Panoramyczna kapilaroskopia przyzębia – nowa metoda diagnostyczna

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Abstract

Objectives. The aim of the research is to analyse *in vivo*, the microcirculation gingival characteristics.

Material and Methods. 35 healthy no-smoker subjects were examined. The characteristics of the gingival microcirculation were examined using computerised videomicroscopic techniques. For each subject, we evaluated the visibility, the course, the tortuosity and any images characteristic for capillary loops, besides, the possible presence of microhaemorrhages, the average calibre of capillary loops and the number of capillary loops visible per square millimetre. The investigation was non invasive and repeatable for each subject.

Results. The investigation of gingival mucous revealed a course of capillary loops both parallel and perpendicular to the surface: close to the marginal gingiva often the tops of the capillary loops appear as dots or commas regularly distributed; close to the papilla, the microcirculation walks more frequently parallel to the surface, and its characteristics are similar to the ungual microcirculation. The calibre of the visible capillary loops was $8,63 \pm 1,08 \mu\text{m}$ (mean \pm SD) close to the papilla. The number of visible capillaries was $14,45 \pm 4,10$ (mean \pm SD) in the area of the marginal gingiva and $8,63 \pm 1,08$ (mean \pm SD) close to the papilla.

Conclusion. Our research has highlighted that today it is possible to carry out a capillaroscopic investigation of oral mucosa in a simple and reliable way. Future research could evaluate how “normal microcirculation”, that we describe in this paper, is modified in periodontal disease (**Dent. Med. Probl. 2004, 41, 3, 449–453**).

Key words: gingiva, capillaroscopy.

Streszczenie

Cel pracy. Analiza mikrokrążenia dziąsłowego *in vitro*.

Materiał i metody. Badania przeprowadzono u 35 zdrowych, niepalących osób. W ocenie mikrokrążenia dziąsłowego wykorzystano techniki komputerowej wideomikroskopii. U każdego badanego określono widoczność, przebieg i inne cechy charakterystyczne dla obrazów pętli włosniczkowych oraz ewentualną obecność mikrokrwotoków, średnicę naczyń włosniczkowych, a także liczbę naczyń na milimetr powierzchni. Badanie nie było inwazyjne, ale powtarzalne.

Wyniki. Badanie dziąsła wykazało przebieg naczyń, zarówno równoległe, jak i prostopadłe do jego powierzchni. W pobliżu dziąsła brzeżnego stwierdzano często górną część naczyń w postaci kropek lub przecinków rozmieszczonych regularnie. W pobliżu brodawek dziąsłowych mikronaczynia częściej uwidaczniały się równoległe do powierzchni, a ich charakterystyki były podobne do mikrokrążenia typu końcowego. Średnica widocznych naczyń w pobliżu brodawek wynosiła $8,63 \pm 1,08 \mu\text{m}$ (średnia \pm odchylenie standardowe). Liczba widocznych naczyń w obszarze dziąsła brzeżnego wynosiła $14,45 \pm 4,1$ (średnia \pm odchylenie standardowe) i $8,63 \pm 1,08$ (średnia \pm odchylenie standardowe) w pobliżu brodawek.

Wnioski. Badania własne dowiodły, że jest możliwe przeprowadzenie kapilaroskopii błony śluzowej jamy ustnej w sposób prosty i wiarygodny. Następne obserwacje powinny wykazać, jak mikrokrążenie w warunkach fizjologicznych, opisane w tej pracy, zmienia się w chorobie przyzębia (**Dent. Med. Probl. 2004, 41, 3, 449–453**).

Słowa kluczowe: dziąsło, kapilaroskopia.

Capillaroscopy is a method used to study the microcirculation that arouses great interest for the possibility it offers for observing *in vivo* small vessels through the use of a microscope [1]. Today, it is becoming more reliable thanks to improvements in the means of observation, the possibility of photography and the advent of the videomicroscope [2, 3].

The examination of the vascular fingernail bed was in the past the fundamental technique in understanding the semiotics of the capillaries [4–6]. Nevertheless, the observation *in vivo* of the microcirculation of the fingernail fold is not always easy because of the presence of a series of factors such as the peculiar anatomical conformation of the fingernail fold, reduced transparency of the skin, and interstitial edema [7–10].

For the above mentioned reasons, it appears opportune to evaluate the usefulness of research *in vivo* of the microcirculation in areas different from that of the fingernail bed; among investigative possibilities gum mucosa and the mucosa covering of the lower lip arouse most interest in the clinical field.

From some studies, it has appeared clear how a capillaroscopy of gingiva could represent an interesting complementary or alternative technique to fingernail capillaroscopy [5, 11–13]. There are several reasons for this: ease of access and execution, reduced influence of mechanical and chemical stimuli present at the oral level, and less sensitivity of oral mucosa to stress resulting from the cold [4, 14–16].

Nevertheless, the study *in vivo* of the microcirculation of gingiva remained confined to the experimental sphere for limitations of a technical and interpretative nature [17, 18]. The technical limits were represented by the difficult positioning of the instruments; the difficulty of immobilising the patient's head; and movement of the patient due to breathing. The limitations of an interpretative nature were due to a lack of understanding of the characteristics of the microcirculation of oral mucosa, which in the most part differs from the classical “comb like aspect of the capillaries” of the fingernail fold [19, 20]. The literature of capillaroscopy has documented how the different investigative centres differ from each other with respect to the position, form, capillary calibre and architectural framework, the latter understood as general microcirculatory organisation [21–23]. This research intends to verify the applicability of an investigation of oral mucosa, using video capillaroscopy, and to describe the characteristics of the capillaries of “normal” oral mucosa, that is to say in physiological terms [16, 24].

Material and Methods

35 no-smoker patients (17 female, 18 male; mean \pm SD age 50 ± 11.60 years; range 25–62 years) were examined in our laboratory (Tab. 1). The subjects were included in the study, if the accurate exam of their medical history and the objective examination of their oral mucous, reported them to be healthy. Oral hygiene was excellent: Loe & Silness gingival index was = 0 in the study area, like the Plaque Index. All the subjects gave their informed consent for processing and use of personal medical data in scientific papers, in accordance to the Italian Law. They were examined by computerised videomicroscopic techniques and related software (Videocap 100, Moritex) [13, 15, 21].

Table 1. Characteristics of subjects enrolled in the study

Tabela 1. Charakterystyka badanych osób

	Healthy no-smoker subjects (Osoby zdrowe, niepalące) (n = 35)
M/F ratio	18/17
Age (mean \pm SD)	50 ± 11.60
Range	25–62

SD – standard deviation.

SD – odchylenie standardowe.

The capillaroscopic investigation was carried out with patients in a sitting position; always with the same source of light, at the same room temperature (23°C), in the morning, with the same operator and repeated twice for each investigated area. The investigated areas for each patient were: the labial gingiva in the area of the inferior 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: visibility of the capillary loops (score from 1 to 4): 1 – simple focusing: within 30 seconds of the start of the examination; 2 – average focusing: over 30 seconds and within 2 minutes; 3 – difficult focusing above 2 minutes; 4 – impossible focusing; orientation with respect to the surface (score A or B or AB): A – course of the capillary loops parallel to the surface; B – course of the capillary loops perpendicular to the surface; AB – both parallel and perpendicular; capillary tortuosity (score from 0 to 3); 0 – absence of crossing in the capillary loops; 1 – presence of crossing; 2 – presence of more crossings; 3 – com-

plete distortion of the capillary loops; microhaemorrhages: score (0 or 1): 0 – absence; 1 – presence; characteristics of the capillary loops: (score 0 or 1): 0 – absence; 1 – presence;

B. Parametric data: number of visible capillary loops in every square millimetre (value obtained from the average of the two observations for each controlled area); calibre of the capillary loops (values obtained from the average of the two observations for each controlled area).

Data analysis was performed using StatView 5.0.1 (SAS Institute Inc., Cary, NC).

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

Results

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

The visibility of the microcirculation was of medium difficulty for 28 subjects, difficult for 7 subjects.

The architecture of the microcirculation of the marginal gingiva does not give evidence of a constantly parallel orientation of the capillary loops in relation to the surface, as does the fingernail bed. In 90% of cases it is possible to visualise only the apex of the capillaries, they appear like regularly distributed dots or commas, resulting in a perpendicular course of the loops with respect to the sur-

face (type B) (Fig. 1); close to the papilla it is possible to observe (80% of cases) a parallel course to the surface (type A), which leads to a complete evaluation of the capillary loop, being visible not the apex but its entire course (Fig. 2).

The tortuosity of the capillaries showed a score equal to 0 in all the cases of marginal gingiva observed; close to the papilla, we observed: score 0 in 28 subjects; score 1 in 5 subjects; score 2 in 2 subjects.

Capillary loops have variable diameters, courses and lengths; next to those with a horse stirrup shape, there are capillary loops, which look like hairpins or commas.

The calibre of the visible capillary loops was $8,63 \pm 1,08 \mu\text{m}$ (mean \pm SD) close to the papilla.

The number of visible capillaries was $14,45 \pm 4,10$ (mean \pm SD) in the area of the marginal gingiva and $8,63 \pm 1,08$ (mean \pm SD) close to the papilla.

The results of the observations are summarised in Table 2.

Discussion

The morphofunctional study of the microcirculation plays a role of prime importance, in fact the microvascular bed is the principal stage for biochemical and immunological events, and the basis of acute and chronic inflammatory processes [15, 17, 21].

Our research points out that capillaroscopy is a reliable method to study periodontal microcirculation [19, 25, 26].

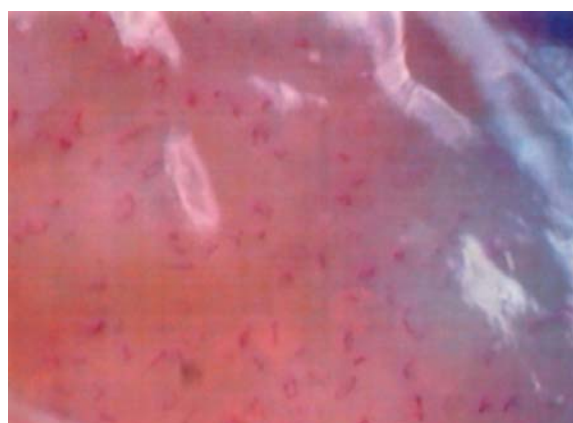


Fig. 1. Marginal gingiva: often (in 90% of the cases) it is possible to visualise only the apex of the capillaries, that appear as regularly distributed dots or comma-like forms (magnification 200 \times)

Ryc. 1. Dziąsło brzeżne – w 90% przypadków uwidoczniono tylko szczyt naczyń jako regularnie rozmieszczone kropki lub przecinki (powiększenie 200 \times)

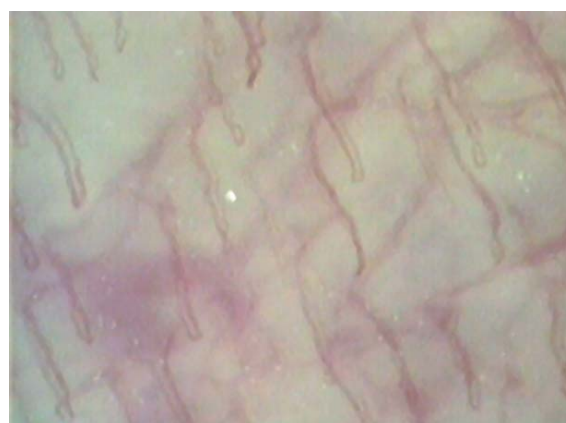


Fig. 2. Papilla: network of capillaries in polygonal mesh and a parallel orientation (type A) with respect to the surface in no-smoker subject (magnification 200 \times)

Ryc. 2. Brodawka – siatka naczyń rozmieszczonych poligonalnie i równoległe do powierzchni u osób niepalących (powiększenie 200 \times)

Table 2. The characteristics of the gingival microcirculation in healthy no-smoker subjects. SD**Tabela 2.** Charakterystyka mikrokrążenia dziąsłowego zdrowych i niepalących osób. SD

	35 patients	
	score	subjects
Orientation with respect to the surface close to the gingiva	B	90%
	AB	8%
	A	2%
Orientation with respect to the surface close to the papilla	A	80%
	AB	12%
	B	8%
Capillary tortuosity close to the gingiva	0	100%
Capillary tortuosity close to the papilla	0	28
	1	5
	2	2
Microhaemorrhages	0	100%
Calibre of the capillary loops close to the papilla (mean \pm SD) Significance ¹ = S	8,63 \pm 1,08 μ m	
N°/mm ² close to the gingiva (mean \pm SD) Significance ¹ = S	14,45 \pm 4,10	
N°/mm ² close to the papilla (mean \pm SD) Significance ¹ = S	8,63 \pm 1,08	

Knowledge of microscopic anatomy is fundamental for the interpretation of the oral vascular examination [8]. In fact, the thickness and typology of epithelium covering, as well as the presence or not of keratinization, are directly implicated in determining the microcirculation visibility and the capillaries length [2, 19, 25].

In the area of masticatory mucous we had some difficulties highlighting the vascular bed. We attributed this to the surface keratinization, and to the notable reduction in the extension of the area under investigation. On the basis of the architectural characteristics, pathological modifications are more easily detectable close to the papilla, where the capillaries course is mostly parallel to the surface; on the contrary, close to the marginal gingiva, is possible to observe the top of the loops

so that the morphologic alterations are difficult to detect. For this reason, it was not possible to observe the presence of tortuosity in the area of the marginal gingiva. Such a result does not prove the absence of tortuosity due to the perpendicular course of the capillary loops in relation to the surface [2, 7, 13, 16, 25].

Microhaemorrhages represent a very rare phenomenon in both sites of examination. We observed a greater number of capillary loops in the marginal gingiva and this must be related to the course of the capillaries with respect to the surface. In conclusion, the videocapillaroscopic periodontal evaluation could today permit the observation of the masticatory mucosa microcirculation *in vivo* and to evaluate the influence of same factors (smoking habit, oral hygiene, etc.) in periodontal health.

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Received: 28.04.2004

Revised: 2.06.2004

Accepted: 4.06.2004

Praca wpłynęła do Redakcji: 28.04.2004 r.

Po recenzji: 2.06.2004 r.

Zaakceptowano do druku: 4.06.2004 r.