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RESEARCH ARTICLE

Anatomical evaluation of oral microcirculation: Capillary characteristics associated with sex or age group

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Abstract

Background: There are various types of oral mucosa specific to different parts of the mouth and each of these has a unique histological structure. The variations in the epithelial structure are consistently related to observable differences in the underlying microcirculation: i.e. differences in the course, conformation, and density of capillaries. The aim of this research has been to investigate oral microcirculatory differences between men and women as well as between various age groups, in order to map the oral mucosa, and to highlight changes occurring during aging.

Methods: A total of 45 healthy subjects were enrolled for this study (12 men and 33 women; mean age 60.37; range 30–82). A complete *in-vivo* videocapillaroscopic mapping of the oral mucosa was done on each subject.

Results: The capillaroscopic patterns of the various areas differ particularly in the course of the loops in relation to the mucosal surface. On the basis of statistical analysis of the collected data, it emerges that there are many differences in capillary loop density between men and women and between different age groups.

Conclusion: This study demonstrates the necessity of approaching the investigation of patient microcirculation in different ways depending on sex or age.

Introduction

The oral mucosa should be considered as a complex unit composed of various anatomical and histological structures sharing the same embryonic origin and the same anatomical location inside the human body. The similarities end here, however.

As a matter of fact, the various types of oral mucosa at different locations have unique histological structures: i.e. differences in the number of cellular layers; presence or absence of the surface keratinized layer; a difference in thickness; and so

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on. All these differences are well known and today it is a common practice to refer to the oral mucosa as: labial mucosa, buccal mucosa, gingival mucosa, alveolar mucosa or lingual mucosa (Scardina et al., 2007a–c).

Till a few years ago, the strict relationship between differences in epithelial structure and noticeable differences in the underlying microcirculation: i.e. differences in capillary course, conformation, and density (Kerdvongbundit et al., 2002), had not been clearly elucidated.

Precise differential analysis, the foundations of which had already been established (Korkushko and Sarkisov, 1976), has become possible over the last few years and been greatly refined thanks to the modern techniques of *in-vivo* capillaroscopic imaging (Scardina et al., 2007a–c; Scardina and Messina, 2003, 2006, 2007, 2008).

Other researchers have demonstrated that adequate mucous microvascular blood flow and tissue oxygen tension are important prerequisites for successful tissue repair. The efficacy of tissue repair is correlated with age, decreasing with increasing age (Kelly et al., 1995; Ogrin et al., 2005; Kerdvongbundit et al., 2003).

The aim of this research has been to investigate differences in oral microcirculation in males and females as well as at various ages, in order to map the oral mucosa, and to prominently present the changes occurring during aging (Malossi and Melchiori, 1984; Li et al., 2006a, b).

Subjects and methods

A total of 45 healthy subjects were enrolled in the study (12 men and 33 women; age 60.37 ± 2.4 (mean $\pm$ SD); range 30–82). All subjects gave their informed consent according to the requirements of Italian law.

Firstly, the subjects were grouped in 2 large groups according to sex (men and women) and each of those groups was subdivided into 3 sub-groups according to age (30–50 years; 50–70 years; beyond 70 years), thus underlining differences according to age and sex differences.

All examined subjects were in good health and they did not show any pathology that could alter microcirculation, especially oral microcirculation. All environmental variables were standardized in order to obtain homogeneous data: same operator; same hour of the day; same temperature.

The examination method used was ''*in-vivo*'' oral videocapillaroscopy. This technique is based on a contact optical probe capillaroscope, the VIDEOCAP 200 (DS Medigroup, Milan Italy).

We used a $200\times$ magnification optical probe with a variable focus, adjustable by a dedicated rotary ring. Every image was frozen, saved and collected by means of a special Videocap Software. After that, the collected images were examined and the following thorough measurements performed: i.e. capillary loop calibre (total diameter, diameter of incoming loop, diameter of outgoing loop); length of capillary loop; density of loops. All measurements were performed by the same operator (GAS) under the same environmental conditions.

A complete capillaroscopic mapping was made for each subject. Examined districts were, in order: labial mucosa; buccal retrocommissural mucosa; sublingual mucosa and gingival mucosa.

We classified the loops course as follows (Curri's classification):

Curri type 1, in which the loops are parallel to the surface;
Curri type 2, in which the loops are perpendicular to the surface.

A mixed pattern, in which we can find both parallel and perpendicular loops.

For Curri types 1 and 2, respectively, it was possible to make linear measurements of the single loops and their density (Figure 1).

Results

Intrasubject variability satisfied the 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, 1 mark difference was observed at most.

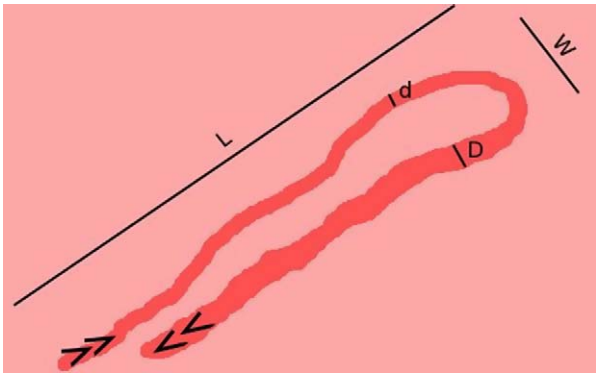

Figure 1. A schematic image of the capillary loop measurements: total length (L), total diameter (W), incoming diameter (d), outgoing diameter (D).