EVALUATION OF DOPPLER ULTRASOUND TECHNOLOGY APPLICATION IN THE DIAGNOSIS OF PERIODONTAL DISEASES

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Abstract

Background: Multiple factors contribute to the development of periodontal diseases, causing significant medical and social concerns. The microcirculatory bed of the periodontal area is vital for metabolic control and rapid response to systemic changes. Inflammatory processes in the periodontium lead to microvascular alterations, including vasodilation and increased blood flow velocity.

While Laser Doppler Flowmetry (LDF) has been used for decades, it faces limitations such as operator pressure on the examination site, probe angle sensitivity, and high equipment costs. Ultrasound Dopplerography (USDG) offers a non-contact, more adjustable alternative for collecting diagnostic data, particularly for asymptomatic stages and the continuous evaluation of treatment efficacy.

Aim: This study aims to evaluate the integral characteristics of ultrasound Dopplerography at various probe positions using Principal Component Analysis (PCA) to improve the diagnostic accuracy of chronic periodontitis.

Materials and Methods

Study Subjects:

The study included 35 participants divided into two groups:

Control Group: 28 "conditionally healthy" individuals (average age: 25 years and 3 months).

Test Group: 7 patients with Moderate Chronic Periodontitis (MCP) (average age: 50 years).

Diagnosis of MCP was based on bone loss (up to 1/2 of the root length), pathological tooth mobility (Miller Class I-II), and probing depths of 4–6 mm.

Microcirculation Assessment:

The "LAKK-02" (NPP LAZMA) system was used for ultrasound Dopplerography. The procedure utilizes the Doppler effect: laser radiation contacts tissues, and the movement of erythrocytes causes a frequency shift. The weighted average volumetric blood flow velocity (Q_{am}, mL/min) was measured. The probe was placed between teeth 2.1 and 2.2 in the vestibular (mucobuccal) fold.

Statistical Analysis:

Data processing was conducted using Stata 18. Analysis of Covariance (ANCOVA) was used to assess the impact of age, followed by One-Way ANOVA. The significance level was set at $p < 0.05$. Levene's test was used to ensure the homogeneity of variances.

Results

ANCOVA analysis ($p = 0.978$) showed no statistically significant differences in group coefficients related to the age variable. Levene's test (0.255, $p > 0.05$) indicated no significant differences between group variances, validating further investigation.

Statistically significant differences in mean volumetric blood flow velocities were observed between healthy subjects and patients with periodontal disease ($p = 0.034$, $F = 3.492$, $df = 1$).

Conclusion

According to the ultrasound Dopplerography findings, the volumetric microcirculation velocity in the periodontium is significantly lower in individuals with moderate chronic periodontitis. This establishes the Q_{am} parameter as an objective diagnostic criterion for hemodynamic defects in periodontal tissues.

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