



ULTRASONOGRAPHIC MEASUREMENT OF PERIODONTAL ATTACHMENT LEVELS

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Abstract

Periodontal disease is one of the two major causes of tooth loss today, and has been associated with several systemic diseases, such as diabetes, cardiovascular disease, stroke, and adverse pregnancy outcomes. Unfortunately, the most widely used diagnostic tool for assessment of periodontal diseases, measurement of periodontal attachment loss with a manual probe, may overestimate attachment loss by as much as 2 mm in untreated sites, while underestimating attachment loss by an even greater margin following treatment. Manual probing is also invasive, which causes patient discomfort.

This work describes the development and testing of an ultrasonographic periodontal probe designed to replace manual probing. It uses a thin stream of water to project an ultrasonic beam into the periodontal pocket and then measures echoes off the periodontal ligament. Development issues addressed in this work included the proper design of the probe tip, which is needed to narrow the ultrasonic beam from a transducer with a 2 mm diameter active area to a 0.5 mm beam, which is the approximate width of the periodontal pocket at the gingival margin. The proper choice of transducer frequency, the proper method for controlling water flow from the probe, and the development of signal processing algorithms to aid in the interpretation of the echoes were also addressed.

To test the ultrasonographic probe, clinical trials were conducted on 12 patients in conjunction with the Old Dominion University School of Dental Hygiene. These tests indicate that probing depth measurements obtained through the ultrasonographic probe do not correlate with manual probing depths, since ultrasonographic probing measures echoes off specific anatomical features, while manual probing measures resistance to probing force. However, ultrasonographic probing did show promise as a diagnostic tool, as ultrasonic probing depth measurements correlated to overall gingival health, as measured by the Gingival Index of Loe and Silness. In addition, ultrasonographic probing, when combined with an automated feature recognition algorithm, showed better repeatability than manual and controlled-force probing.