Development of ICG Assisted NIR Dental Fluorescence Imaging with Mouthwash for Diagnosis of Dental Disorders

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Abstract

Dental caries and tooth cracks are common disorders that can greatly impact oral health if they left untreated. Early detection of the disorders is important for proper treatments to prevent the progress of the disease. Currently, X-ray based imaging is the most popular method in dental examinations; however, this method is harmful to the human body because of the ionizing radiation of X-ray. This study aims to develop an ionizing radiation-free, indocyanine green (ICG) assisted near-infrared (NIR) system to image dental structures and to detect dental caries and tooth cracks. Fluorescent ICG dye was formulated into a solution to treat human extracted teeth. The solution was used as a mouthwash to treat rats in comparison with injection methods for delivery of the ICG dye. NIR fluorescence imaging system was performed to acquire images of human teeth and dental images of rat molars. The results illustrate that better image contrast and shorter imaging time (1-10 minutes) were achieved by delivering the dye with the mouthwash method than the subcutaneous injection in the rat study. While both mouthwash and injection methods for ICG delivery showed effectiveness to image dental structure of the erupted and un-erupted molars by an endoscope, mouthwash required much less dosage with better image contrast than the injection. After ICG solution treatment of human

extracted teeth, the tooth cracks could be easily identified, and caries became bright dots ready to be diagnosed.

Summary

ICG assisted NIR imaging with mouthwash ICG delivery has the potential to become a new, non-ionizing radiation and efficient dental imaging system for diagnosing dental disorders.