In Vitro Model Development Using an Optical Fluorescence Technique

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ABSTRACT

The development of models using techniques capable of minimizing artifacts, reducing total work time, and producing highly reliable data are of continuing interest to our research efforts. **Objective:** The purpose of this study was to determine the applicability of an optical fluorescence technique (QLF, Inspektor Research Systems) for conducting *in vitro* model studies in a more time efficient manner. **Methods:** Cores of human enamel were prepared and mounted using standard procedures. Baseline images using the QLF system were taken on each specimen. Specimens were then exposed to demineralization media for a period of a)24, b)48, or c)72 hours. QLF images were again obtained following demineralization. Specimens were then placed in pooled human saliva and lesions followed in time to determine if reversal occurred. QLF images were captured at 2, 24, 48, and 72 hours. **Results:** ΔQ values for each time point were: a) -27.6, -10.2, -6.1, -4.8; b) -55.4, -37.2, -7.9, -7.3; c) –64.8, -58.1, -36.8, -26.3. By the 72 hour remineralization time point, ΔQ demonstrated a = b > c. Future use of this model to detect product differences is advised using only the 72 hour lesion. The lesions remineralized so quickly with the 24 and 48-hour lesions that product differences would not likely be detected. **Conclusions:** The QLF system was able to track remineralization of three severities of lesions. As *in vitro* QLF and TMR results have been demonstrated to correlate well, these results suggest a potential for significant reduction in time and effort with the use of QLF over conventional microradiographic based efforts. The applicability of optical fluorescence as a tool for tracking changes in early caries lesions has been demonstrated.

INTRODUCTION

QLF, Quantative Light-Induced Fluorescence is a non-destructive method used for early caries detection. Relevant studies in the literature (both *in vitro* and *in vivo*) suggest QLF is a powerful tool for detecting and quantifying the early stages of the caries process.

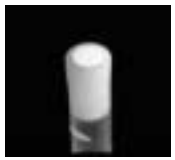
PURPOSE

The purpose of this study was to determine the applicability of an optical fluorescence technique (QLF, Inspektor Research Systems) for conducting *in vitro* model studies in a more time efficient manner.

MATERIALS AND METHODS

Specimens were prepared from cores of human enamel. The enamel specimens were ground and polished to remove the natural fluoride rich outer surface. Baseline images were obtained using the QLF system. Specimens were randomized into 3 groups containing 3 specimens each and placed in 25 mls of demineralizing solution maintained at 37°C for either 24, 48 or 72 hours. The demineralizing solution consisted of 0.1M/L Lactic acid, 0.2% Carbopol, 50% saturated with respect to HAP at pH 5.0. Specimens were removed from the demineralizing solution at the appropriate time point and post-demin QLF images were obtained. Specimens were stored in a humid environment until the demineralization segment was complete for all groups. All specimens were then placed in pooled human saliva, refreshed 4 times daily. QLF images were obtained at 2, 24, 48 and 72 hours to monitor lesion reversal over time as a function of salivary remineralization.

Cored human enamel chip



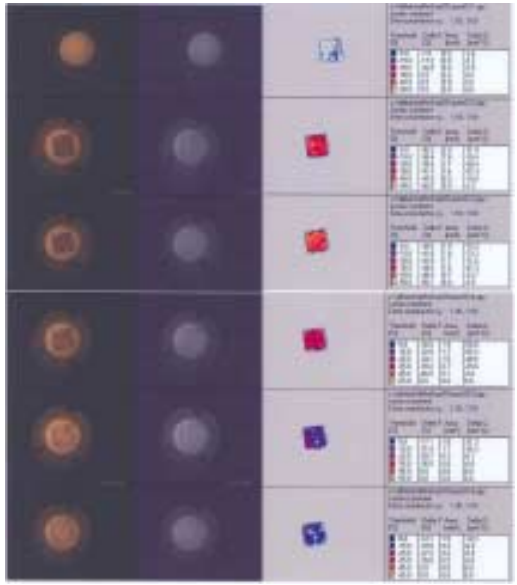
Ground polished enamel specimen

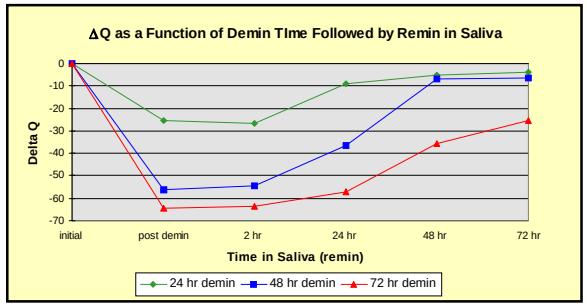
DISCUSSION

Remineralization was demonstrated for all specimens regardless of the time of demineralization. However, the 24 and 48 hour lesions remineralized so quickly upon exposure to saliva alone that the use of such mildly demineralized specimens may not be optimal for use in studying potential differences in product performance. The 72 hour lesion appears to be a better option for studying potential product effects due to the combination of: 1) QLF's ability to clearly detect the lesion, 2) the slower response of these lesions to remineralization from saliva alone.

This study utilized cored, ground and polished specimens prepared from human enamel. Preparation of these specimens is very time consuming and takes a high level of expertise. Although cored specimens were used for the present study, one proposed benefit of the QLF system is its ability to use whole teeth rather than highly prepared (corded, mounted, polished) specimens. Further work is our laboratory has confirmed this benefit.

RESULTS/DATA





CONCLUSION

- This study affirms the use of QLF as a quantitative tool for detecting changes in early caries lesions.
- A 72 hour carbopol lesion is more appropriate for studying potential product differences than less severe lesions.
- The QLF system provides a significant reduction in total work time and effort while providing highly reliable data.

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