Detection of Caries Around Amalgam Restorations Using Four Different Modalities

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Introduction

- ❑ It is a challenge clinically, detecting carious lesions beneath amalgam restorations, as amalgam is a radiopaque material.
- ❑ Visual examination and radiographs are commonly used techniques for caries detection clinically, in North America.
- ❑ Radiographs can detect lesions beneath amalgams, if they are located on an interproximal surface on the gingival floor of the restoration
- ❑ Wall lesions on the tooth may not be found visually or with radiographs depending on their positions and size.

Objectives

The aim of this study was to evaluate the ability of PTR-LUM (The Canary System, CS), laser fluorescence (DIAGNOdent, DD), LED fluorescence (Spectra), and visual inspection (ICDAS II) to detect natural decay around bonded amalgam restorations in vitro.

Materials & Methods

- ❑ 17 extracted human molars and premolars, consisting of 5 visually-healthy and 12 teeth with natural cavitated lesions were selected.
- ❑ For the carious teeth, caries was removed leaving some decayed tissues on the floor and or wall of the preparation.
- ❑ For sound teeth, 3 mm. deep cavity preps were made and teeth were restored with bonded-amalgams.
- ❑ 36 sites (13 sound sites; 23 carious sites) were selected.
- ❑ CS and DD scans were performed in triplicate at 2, 1.5, 0.5, and 0 mm away from margin of the restoration (MOR).
- ❑ Spectra images were captured for the entire surface, and dentists blinded to the samples provided ICDAS II scoring.

Results

The Canary Scale

Figure 1. The Canary Scale is a relative scale of 0 - 100 that reflects the state of tooth mineralization and crystallization. This is a graduated scale where lower numbers indicate sound enamel and higher numbers indicate more advanced tooth decay.

DIAGNOdent Scale

DIAGNOdent Scale (KaVo DIAGNOdent 2095 Operating Instructions)	
Display value	Clinical Situation
0-10	Healthy tooth structure
11-99	Caries

Figure 2. The DIAGNOdent Scale. Reference: "The DIAGNOdent Scale." *KaVo USA*. KaVo Dental Corporation, 2016. Web.

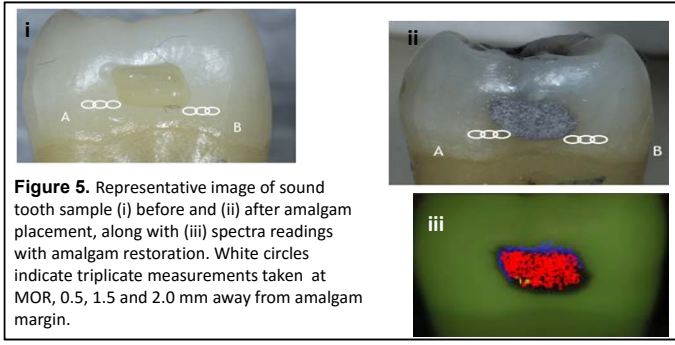

Figure 5. Representative image of sound tooth sample (i) before and (ii) after amalgam placement, along with (iii) spectra readings with amalgam restoration. White circles indicate triplicate measurements taken at MOR, 0.5, 1.5 and 2.0 mm away from amalgam margin.

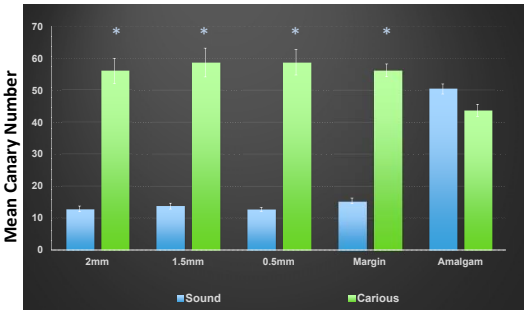

Figure 3. Mean Canary Numbers at MOR, 0.5, 1.5 and 2 mm from the margin into tooth structure for sound teeth and carious teeth. Asterisks (*) indicate statistical significance at P<0.05.

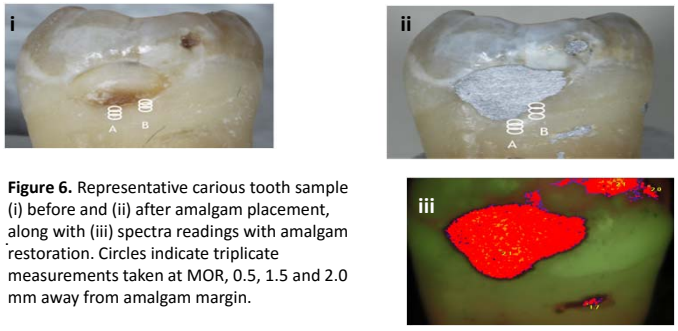

Figure 6. Representative carious tooth sample (i) before and (ii) after amalgam placement, along with (iii) spectra readings with amalgam restoration. Circles indicate triplicate measurements taken at MOR, 0.5, 1.5 and 2.0 mm away from amalgam margin.

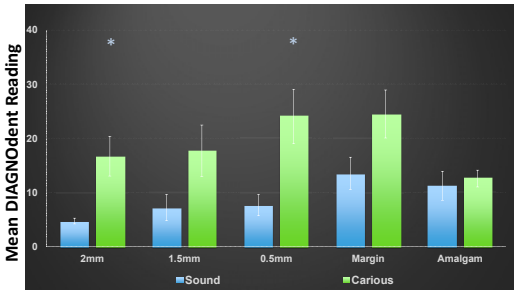

Figure 4. Mean peak values for DD at MOR, 0.5, 1.5 and 2 mm from the margin into tooth structure for sound teeth and carious teeth. The asterisks indicate statistical significance at P<0.05.

Sensitivity and Specificity

Sound Teeth	CN	DD
2 mm	100%	100%
1.5 mm	92%	85%
0.5 mm	100%	85%
MOR	85%	54%

Table 1. Specificity rankings for sound samples.

Carious Teeth	CN	DD
2 mm	95%	52%
1.5 mm	95%	45%
0.5 mm	96%	65%
MOR	100%	74%

Table 2. Sensitivity rankings for carious samples.

Discussion

- ❑ CS exhibited high sensitivity and specificity right up to the MOR without interference from amalgam and was able to differentiate healthy from carious tissues.
- ❑ DD exhibited poorer specificity than CS because of false positives generated due to presence of amalgam material, organic and/or microbial debris.
- ❑ DD exhibited poorer sensitivity than CS because of false negatives generated from carious samples. DD is unable to detect caries unless it is directly overtop the lesion.
- ❑ DD was unable to consistently differentiate sound from carious tissue at various distances from the MOR.
- ❑ Spectra data and images were inconclusive due to signal interference from the amalgam.
- ❑ ICDAS II sensitivity and specificity were 1.0 and 0.17.

Conclusion

❑ The Canary System has the potential to detect secondary caries around amalgam restorations more accurately than the other investigated modalities.