New diagnostic technology and hidden pits and fissures caries

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Abstract

The accuracy in pits and fissures caries detection is of paramount importance in dental caries primary and secondary prevention. A combination of visual examination and probing is currently the mainstay of occlusal caries diagnosis. Unfortunately, these types of inspection alone may leave a certain number of pit and fissure caries undetected. The Vista Cam iX fluorescence camera (Durr Dental, Bietigheim-Bissingen, Germany) is a novel dental diagnostic tool for quantitative assessment of dental caries with high specificity for carious lesions detection. In the presented cases photographic images, representing the visual diagnostic approach, are applied as integration to VistaCam iX Proof images. A step-by-step sequence of inspection and assessment of operative treatment need is presented in a case of hidden pit and fissure caries on a permanent molar. Based on the reported case, it could be observed that VistaCam iX Proof shows promising results in hidden pits and fissures caries detection and could be considered a non-invasive examination method that facilitate the detection of early lesions and a potential diagnostic aid.

Keywords: *Pit and fissure caries; Fluorescence camera; ICDAS II.*

Introduction

The accuracy in caries detection is of paramount importance in dental caries primary and secondary prevention. The detection and diagnosis of pits and fissures occlusal caries on early stages and the evaluation of lesion depth have frequently been included in those clinical issues, due to complex anatomy of pits and fissures, accumulation of calculus, plaque or other contaminants that may interfere with diagnosis [1].

Dentin caries can often be detected underlying a macroscopically sound enamel occlusal surface. Two clinical cases are reported to show the technological aiding tool usage to this important issue. Using of fluorescence-based camera VistaCam iX (Durr Dental, Bietigheim -Bissingen, Germany) is here compared to visual inspection in occlusal "hidden" dentin caries detection.

Materials and methods

A combination of visual inspection (with or without probing) and radiography is currently the mainstay of occlusal caries detection. Unfortunately, these types of inspection show low sensitivity and specificity and may leave a several number of pit and fissure caries undetected. According to Pitts et al., pit and fissures exploration with a sharp probe does not improve the diagnostic performance and may damage demineralized enamel and accelerate the carious process [2] while bitewing radiographs sensitivity and specificity in detecting small occlusal caries lesion is low due to the overlapping of tooth structure [3]. Technological aiding diagnostic tool is applied in this study in accordance to the new caries detection and assessment systems.

The International Caries Detection and Assessment System (ICDAS-II) indicate visual inspection to score caries lesions. ICDAS-II codes are:

0 = sound;
1 = first visible sign of noncavitated lesion seen only when the tooth is dried;
2 = visible noncavitated lesion seen when wet and dry;
3 = microcavitation in enamel;
4 = noncavitated lesion extending into dentine seen as an undermining shadow;
5 = small cavitated lesion with visible dentine: less than 50% of surface;
6 = large cavitated lesions with visible dentine in more than 50% of the surface.

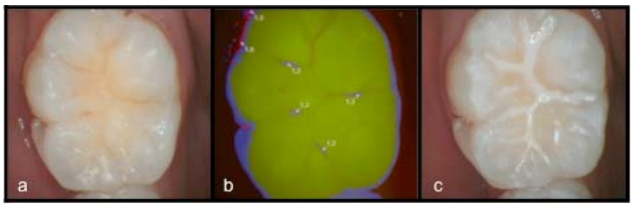

Figure 1. Patient 1. a Clinical occlusal view beforetreatment. b VistaCam iX Proof occlusal image before treatment. c Clinical occlusal view after treatment with white fissure sealant (Grandio Seal, VOCO GmbH, Germany).

The Vista Cam iX (Durr Dental, Bietigheim-Bissingen, Germany) intraoral self-calibrating fluorescence camera is a novel dental non-destructive, optical instrument and diagnostic tool for quantitative assessment of dental caries with a high sensitivity for demineralized lesions detection in enamel and dentin. The phenomenon of dental hard tissue fluorescence was first described in 1911 [4]. The Vista Cam iX LEDs emits high-energy blue-violet light at 405 nm on the occlusal tooth area. At this wavelength porphyrins produced by caries-related bacteria, emit red light, containing less energy, in contrast to sound enamel, characterized by green light [5,6]. Carious tissue and healthy tissue emit fluorescence at different intensities when excited by light at specific wavelengths. The fluorescence is recorded by the camera, transferred and processed by a software (DBSWIN, Durr) and then stored. As result a digital image show lesions in different colours shades with numerical score between 0 and 3, predicting the extent and depth of carious demineralization. Working in accordance with this principle, Vista Cam iX fluorescence camera can improve the diagnosis of so-called "hidden caries". Specifically, occlusal dentin caries lesions in permanent and deciduous teeth underlying a clinically intact tooth surface can be detected. The device is easy to handle in general practice and offer a non- invasive tool for occlusal caries detection.

Two clinical cases are illustrated. One calibrated and trained dentist performed measurements. The inclusion criteria were permanent molars with ICDAS occlusal lesions codes 1 and 2. The exclusion criteria of the analysed dental surfaces were presence of enamel defects (hypomineralization or hypoplasia), intrinsic or extrinsic staining and visible restorations. All teeth were cleaned and dried. Using the VistaCam iX fluorescence-based camera, images of all occlusal tooth surfaces were taken. In this study photographic images, representing the visual diagnostic approach, are applied as integration to VistaCam iX Proof images. A step-by-step procedure of inspection and assessment of operative treatment need is presented in two cases of hidden pit and fissure caries on permanent molars.

VistaCam measurements were taken under cotton roll isolation and after tooth drying with air pressure. The outcome value, ranging from 0 to 3 corresponds to the lesion's severity and represents the intensity ratio of the red and green fluorescence. According to manufacturer's scale:
0-0.9=sound enamel; >0.9-1.5= initial caries, beginning enamel caries; >1.5-2= enamel caries to enamel-dentin limit; >2.0-2.5= dentin caries; >2.5= deep dentine caries.

Case 1.

J. J. F. 8 years old boy, with no pit and fissure obvious caries detection on first left lower molar - ICDAS code 1. VistaCam value 1.3 confirming visual assessment.
White fissure sealant (Grandio Seal, VOCO GmbH, Germany) was applied after dam positioning in according to manufacturer instructions.

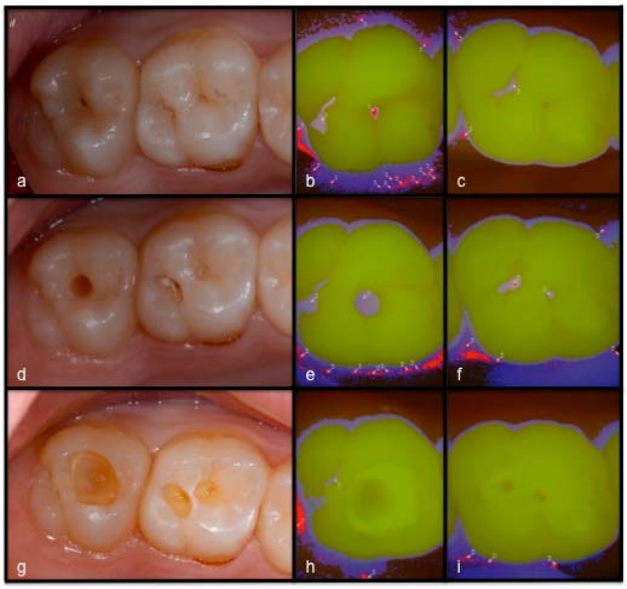

Figure 2 Patient 2. a Clinical occlusal view before treatment. b, c VistaCam iX Proof occlusal view before treatment. d Clinical occlusal view during carious excavation. e, f VistaCam iX Proof intra-operative occlusal view showing caries evidence. g Clinical occlusal view after complete excavation of the carious lesions. h, i VistaCam iX Proof occlusal view after complete excavation of the carious lesions.

Case 2.

M. S. 14 years old girl, with no pit and fissure obvious caries disease on first and second upper left molars. ICDAS Code 1 on first and code 2 on second molar respectively. VistaCam values were 1.7 on 2nd upper left molar and 1.5 on first upper left molar. A second trained operator performed operative pit and fissures inspection.

Local anaesthesia was given and enamel margins were removed with diamond burs in a high-speed handpiece. Obvious underlying dentin caries were detected and excavated with a conventional steel round bur at a speed of 700 r.p.m. with water cooling.

The endpoint of caries removal of the air-dried cavities was determined using a sharp explorer to differentiate carious from sound dentine: cavity preparation was considered complete when dentine was hard to a dental probe.

VistaCam measurements and digital photographs were taken when there was no more caries evidence.

Figure 3. Patient 2. Clinical occlusal view after treatment.

Results

The present study shows how technological diagnostic aids can improve the accuracy in pits and fissures caries diagnosis.

When there is evidence of ICDAS 1 and 2 caries early lesions in a permanent molar, sealants application on occlusal pits and fissures is allowed. Underlying hidden dentine caries detection turns instead to operative treatment option.

The clinical procedure consisted in carious tissue removal and preventive resin restoration (PRR) [7] with a minimally invasive approach.

Conclusion

Based on the reported cases, it could be observed that Vista Cam iX Proof shows promising results in hidden pits and fissures caries detection and could be considered a non-invasive examination method that facilitate the detection of early lesions. VistaCam allow also lesions monitoring over time.

This possibility is of great importance in the field of preventive and minimally invasive dentistry, because it allow to quantitatively identify progressing lesions, which is impossible with conventional tools [8]. Minimally invasive dentistry is the new trend in modern dentistry which allows optimal aesthetic outcome together with maximum conservation of sound tissues [9, 10].

Disclosure

The authors have no financial interest in any of the companies or products mentioned in this article.

Authorship

Fabrizio Guerra and Debora Pasqualotto designed and revised the study.

Denise Corridore, Marta Mazur, Francesca Rinaldo and Daniele Salvi collaborated in the collection of data, writing and preparation of the manuscript.

Livia Ottolenghi and Gianna M. Nardi coordinated the study, revised and provided final approval of the manuscript.

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