

Challenges in diagnosing and managing non-cavitated occlusal caries lesions. A Literature overview and a report of a case

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Abstract

Aim. Aim of this literature overview was to analyze the diagnostic procedures of hidden caries lesions and to present a restorative protocol.

Methods. A literature overview was performed in order to evaluate hidden caries etiological hypothesis and the reported prevalence. The diagnostic procedure is performed with the aid of an intra-oral fluorescence based camera and the restorative procedure is completed with the use of a novel bisphenol-A free composite.

Results. Non cavitated occlusal caries lesions prevalence is high in young adults population. Diagnosis of hidden caries requires both high sensitivity and specificity.

Conclusions. The novel diagnostic and restorative protocol showed to be highly effective in hidden caries assessment and restoration. *Clin Ter 2021; 172 (1):e80-86. doi: 10.7417/CT.2021.2288*

Key words: hidden caries, florescence, intra-oral camera, ormocer, bisphenol-A free composite, non cavitated occlusal lesions

Clinical significance

Non cavitated occlusal lesions, called also hidden caries, show an increasing prevalence in a young adults population. The minimally invasive and digital dentistry orientation led us to a new diagnostic and operative approach.

Introduction

Hidden caries was firstly defined in 1986 as a dentine lesion under a sound or minimally demineralized enamel (1). No consensus exists on the etiology of these lesions, the most common reported etiological factors are: anatomical

complexity and deep fissures, low PH feeding on pre-existing demineralized enamel, fluoride syndrome, specific microbiota, resorption of intracoronary dentin in the pre-eruptive phase and defect in the occlusal fissure (2). The fluoride etiology (routine and systematic use of fluoride favoring the remineralization of the enamel surface while the lesion would progress in dentin) was confirmed by Sawle and Andlaw in 1988 (3) and five years later by Lussi (4). In 2006 Lynch and Ten Cate concluded that at low pH the minerals lost by the dentin can be passed to the enamel, remineralizing it and leading to the hidden caries development (5).

Since 1970 the pattern and prevalence of dental caries in permanent teeth have revealed a marked change (6). Occlusal caries beneath pits and fissures, as well as clinically undetected occlusal caries beneath pits and fissures actually represented about 50% of total caries in many world communities (7). Prevalence data range from 2.2% to 42% and it was reported to be high in young adults, especially on lower first molars (8,9).

Ekstrand (10) reported that a combination of visual inspection (with or without probing) and bitewing radiographs are the mainstay of occlusal caries detection, but in certain cases, these procedures show low sensitivity and specificity and this may leave a several numbers of caries undetected (2,11). On the other hand, Weerheijm *et al.* considered hidden caries as a major problem for dentistry, because of the difficulty in standardizing the diagnosis and establishing a treatment plan (7), especially because this lesion is characterized by a silent progression and require special diagnostic care for early diagnosis. No radiographic evidence on bitewing is present until the lesion has arrived and spread into the dentine (2).

A recent *in vitro* study aimed to verify the limitations of conventional tests for the detection of incipient caries (6), compared the diagnosis agreement among different examiners between the visual and radiographic exam and computed microtomography images of incipient dental lesions on the occlusal surfaces. The Authors documented the low accuracy of conventional exams to detect the lesions (6).

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This low sensitivity and specificity may be due to the nature of the two-dimensional and low-quality images (12).

Several non-invasive physicochemical methods have been developed during the last two decades to detect, measure, and monitor early caries lesions. Among these, fluorescence-based cameras are probably the best-tested technology, with no x-rays side effects and high sensitivity on hidden caries lesions. The intraoral camera is a faster and less invasive diagnostic tool, especially with care to the youngest (13).

Moreover, when a direct restoration of the occlusal surface has to be performed, the clinical steps are highly sensitive to operator handling, and the final functional and esthetic result outcome often lack predictability, as the success rate is based on operator skills and experience and the available clinical time.

The reproduction of the occlusal morphology has been previously described in Literature, but never employing a nano-hybrid ceramic-based restorative material in a young population, where the occlusal morphology is more often present at the moment of the diagnosis, and never in connection with the intraoral camera as the elective diagnostic tool.

The aim of this clinical report was to describe a new approach with:

- The use of a fluorescence intraoral camera as a non-invasive diagnostic tool and a
- Reconstructive time saving procedure with a predictable functional and esthetic result with a nano-hybrid ceramic based restorative material.

Material and Methods

Diagnostics: Intraoral fluorescence camera

The VistaCam iX (Durr Dental, Bietigheim- Bissingen, Germany) intraoral self-calibrating fluorescence camera is a novel dental optical diagnostic tool for quantitative assessment of dental caries with a high sensitivity for demineralized enamel and dentin lesions. The phenomenon of dental hard tissue fluorescence was first described in 1911 (14). 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 (15,16). Transmitted light is scattered in this region, and measuring the differences between reflected light of carious and sound enamel renders both qualitative and quantitative ways to detect lesions. 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 the on-board software (DBSWIN, Durr) and then stored. As a result, a digital image shows lesions in different colors shades with a numerical score between 0 and 3, predicting the extent and depth of carious demineralization. Working in accordance with this principle, the VistaCam fluorescence-based camera can improve the diagnosis of so-called "hidden caries". Specifically, occlusal dentin caries

lesions 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.

VistaCam measurement is performed assessing the cavity extension. For the later evaluation, the VistaCam values were classified as follows : 0–1.2 = sound; 1.3–1.5 = enamel caries; >1.5 = dentine caries; instead of the previously cutoff proposed by the manufacturer : 0–1 = sound; 1–1.5 = initial enamel demineralization; 1.5-2 = deep enamel decay; >2=dentine caries (17,18).

Restorative material and procedure

VistaCam measurement is performed assessing the cavity extension. For the later evaluation, the VistaCam values were classified as follows : 0–1.2 = sound; 1.3–1.5 = enamel caries; >1.5 = dentine caries. (Jablonski-Momeni, Liebegall, Stoll, Heinzl- Gutenbrunner, & Pieper, 2013) instead of the previously cutoff proposed by the manufacturer : 0–1 = sound; 1–1.5 = initial enamel demineralization; 1.5-2 = deep enamel decay; >2=dentine caries (17,18)

Restorative material and procedure

A universal nano-hybrid ceramic-based restorative material (Admira Fusion, Voco) is used in the restorative procedure. Clinical steps are described in the below case report presentation.

Case presentation

The diagnostic procedure is completed with the use of VistaCam fluorescence-based camera. The assessment thresholds >1.5 were used to define dentine caries.

Figures (1-3) show a direct correlation of the objective evaluation of non cavitated occlusal lesions to the VistaCam assessments.

Figure 1 demonstrates the clinical view of the occlusal surface of 4.6 and the corresponding VistaCam assessment with 2.0 score, indicating caries with the extent to dentine.

Figure 2 shows VistaCam assessment (B) of non-cavitated dentine caries (VistaCam score 1.9) close to a pre-existing direct resin restoration.

Figure 3 displays the clinical view of two measurement points: one on the central fossa and one on the distal fossa with non-cavitated caries lesions. Figure 3B shows the VistaCam assessment with 1.7 and 1.6 scores, respectively, in both cases indicating deep enamel caries with the extent to dentine.

Restorative technique

1. VistaCam measurement is performed assessing the cavity extension. For the later evaluation, the VistaCam values were classified as follows: 0–1.2 = sound; 1.3–1.5 enamel caries; >1.5 = dentine caries (18). Fig. 4 a-b

2. The occlusal impression is taken prior to tooth preparation, Fig. 4 c

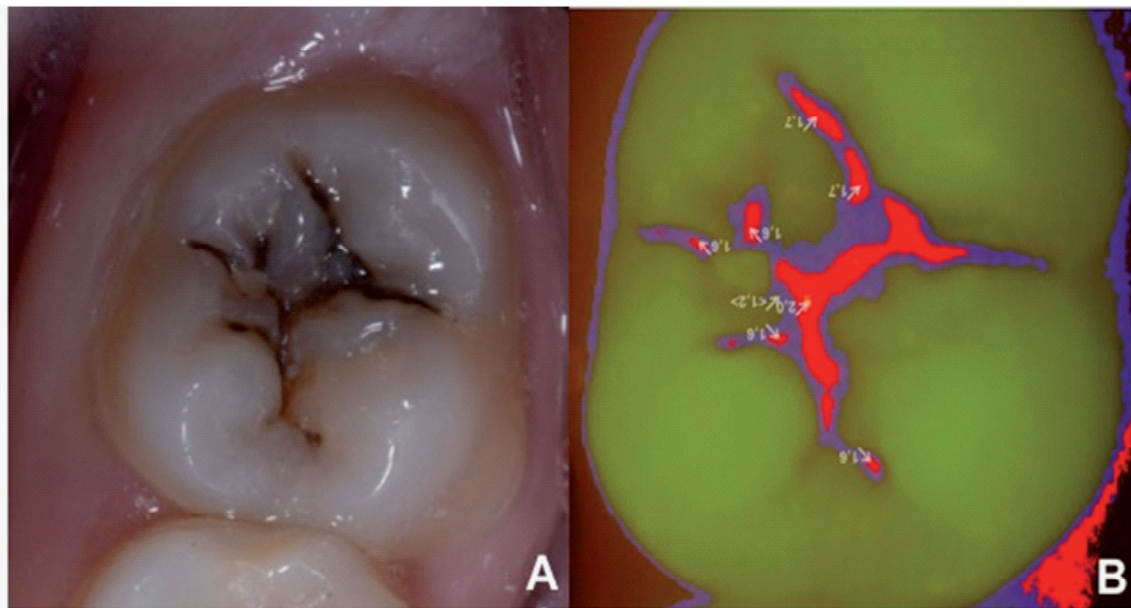


Figure 1. Clinical view of the occlusal surface of 4.6 and the corresponding VistaCam assessment with 2.0 score, indicating a caries with extent to dentine.

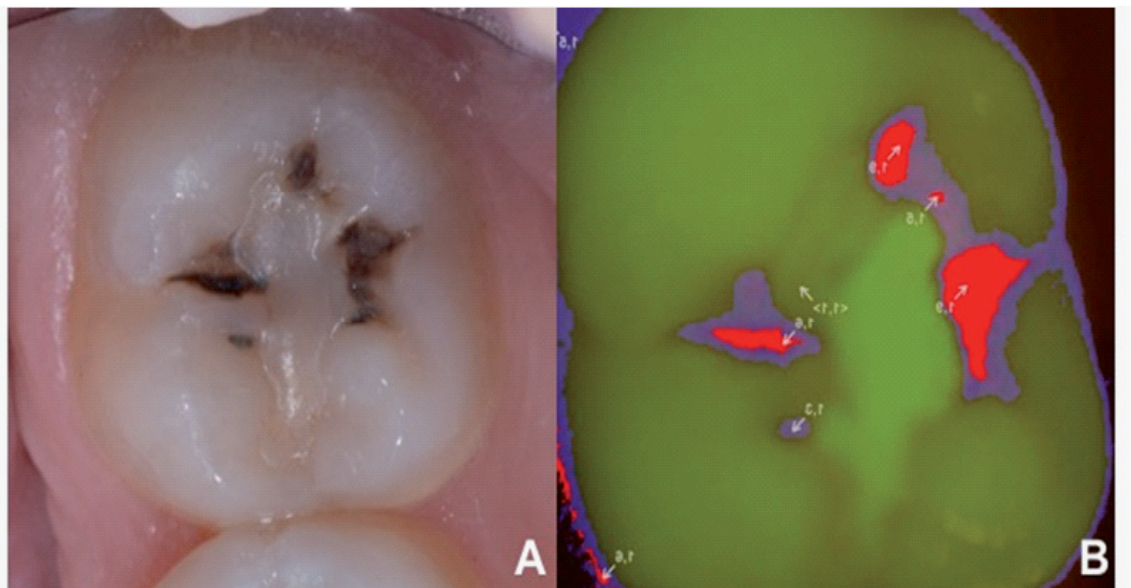


Figure 2. VistaCam assessment (B) shows a non-cavitated dentine caries (VistaCam score 1.9) close to a pre-existing direct resin restoration

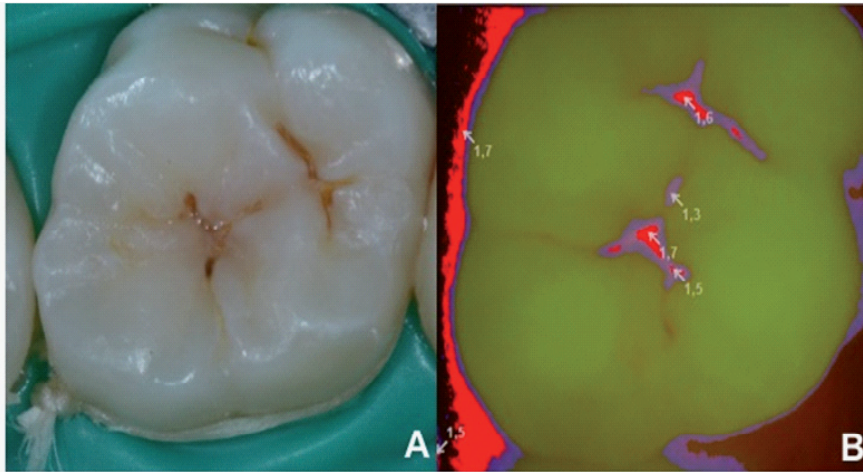


Figure 3. Clinical view of two measurement points: central fossa and distal fossa with non-cavitated caries lesions. Figure 3B shows the VistaCam assessment of 1.7 and 1.6 respectively, in both cases indicating a deep enamel caries with extent to dentine.

3. Anesthesia is given, a rubber dam is placed and the carious tissue is removed. Fig. 4 d

4. After cavity preparation, enamel etching and bonding procedures are performed (Futurabond® U SingleDose, Voco). In accordance with the manufacturer’s instructions for Futurabond® U SingleDose, following blister activation, a homogeneous adhesive mixture was produced by continuous stirring with the supplied Single Tim applicator (Voco GmbH) and rubbed into the enamel and dentine surfaces for 20 s using the applicator brush. The homogeneous adhesive mixture was air-dried for 5 s and light irradiated for 10 s

using a bluephase® style (Ivoclar Vivadent) light-emitting diode, Fig. 4 e-f

5. A flowable nano-hybrid purely ceramic-based restorative material (Admira Fusion, x base, Voco GmbH , Cuxhaven, Germany) is applied as a cavity liner. The flowable composite resin is thinly distributed to provide a more regular cavity conformation, especially at the angles of the cavity and in irregular areas of the pulpal floor 21 (19). The ideal thickness of the lining resin is 0.2-0.3mm. Light cure according to the manufacturer’s instruction.

6. The horizontal incremental technique involved the

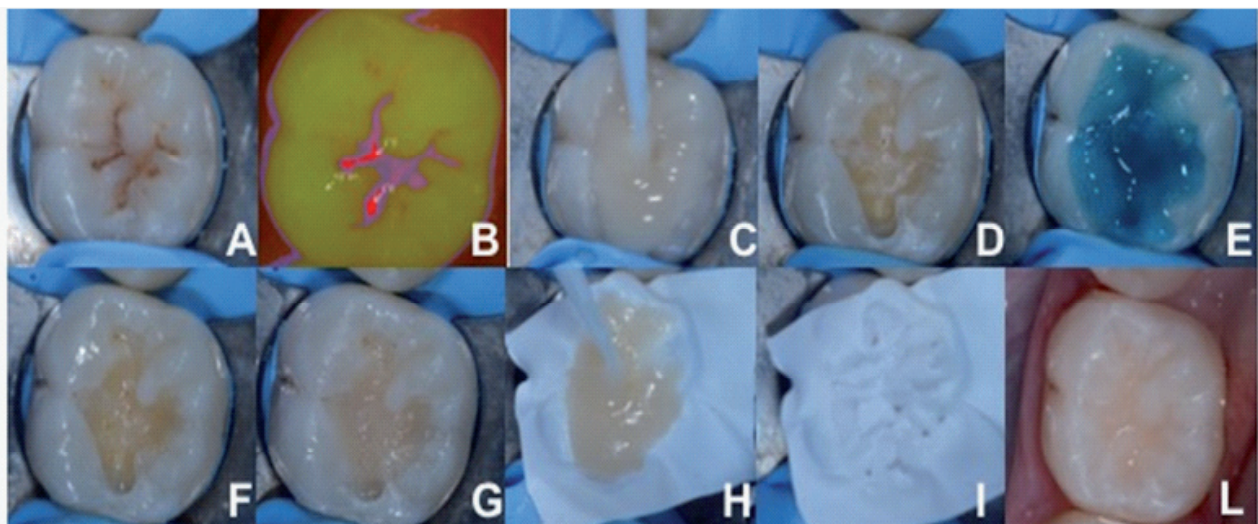


Figure 4. A-L are shown the clinical steps from diagnosis to direct resin restoration.

rehabilitation (26,27), and if not diagnosed the hidden caries placement of two horizontal increments (~4.0 mm thickness) of the restorative material (Admira Fusion, Shade A3.5, Voco GmbH, Cuxhaven, Germany) Fig 4 g.

7. The impression taken prior to tooth preparation was then seated back on the tooth and pressure placed on the impression, to form the unset composite. The composite underlying has to be separated from the impression by a small piece of Teflon type. Fig. 4 h-i

The impression acted as a die to reform the original anatomy and occlusion, then light-curing was performed. Since only a slight excess of composite was placed, the flash was greatly reduced while the occlusal anatomy was formed as it was in the original tooth, reducing finishing and polishing time, leaving the surface of the composite as smooth as the original tooth. Fig. 1

Discussion

This case report study showed a new diagnostic and reconstructive approach in managing hidden caries lesions, with the combined use of a fluorescence-based camera and a nano-hybrid ceramic based material.

Hidden caries affect the young adult population and are insufficiently diagnosed on a routine basis, due to the lesion's configuration and to lack of pain symptoms. Dental practitioners require routinely orthopantomography and bitewings, but several studies have shown that these examinations demonstrate low sensitivity and specificity for hidden caries detection, due to enamel layers superimposition. Rx bitewings begin to be sensitive only at the stage of deep dentine cavities, frequently when the patient starts to have pain like symptoms (6). In addition, a young adult population needs to be monitored for the progression of the lesions, and it may lead to an over x-ray exposition over time. Visual inspection also showed to be non-sensitive in hidden caries diagnosis; moreover, it is depending on the operator's experience and screening conditions (11). In addition, the development of caries is based on a multifactorial process, with environmental, dietary, immunological and genetic factors (22-25). Patients with caries often require an esthetic rehabilitation (26,27). If not diagnosed the hidden caries may cause tooth loss and the necessity of more invasive therapies (28,29).

This study presents a new diagnostic strategy for hidden caries lesions in order to reduce the use of ionizing radiation and operator-dependending diagnostic methods and to determine optimal operative care based on a reliable diagnostic examination.

VistaCam (Durr Dental, Bietigheim-Bissingen, Germany) proved high sensitivity and specificity in detecting caries lesions at various stages (17,18). Due to its good performance, clinical practicability and x-rays freeness, VistaCam might be preferred over x-ray examinations. Moreover, VistaCam can be used both by novice than experienced examiners, in both cases showing high reproducibility and might be preferred to those visual diagnostic procedures that are operator-dependent (18).

Many restorative techniques are available to provide both good function and esthetic. In literature, the Layering and the

Bulk Fill restorative techniques are widely described (20,21). The layering technique developed to minimize the resin composite polymerization shrinkage and the Bulk Fill Technique simpler than the traditional incremental layering with lower shrinkage rates. Therefore, the filling technique for posterior teeth should guarantee a correct accommodation of composite, especially to cavity margins, proper reconstruction of anatomy, and reduction of the inherent shrinkage stress generated by the polymerization contraction (22).

However the resin composite technique, the clinical steps are highly sensitive to operator handling, and the final functional and esthetic result outcome often lack predictability, as the success rate is based on operator skills and experience and the available clinical time. Recently, some authors have identified the lack of correlation between patient's habitual occlusion and a restoration's anatomical morphology as a significant cause of premature composite wear (23,24).

The reproduction of occlusal morphology while restoring tooth has been previously described by Baratieri (25), Hamilton JC (26), Araujo Jr (27). To our knowledge, no studies have been published on Admira Fusion (VOCO), a universal nanohybrid ormocer, thus far.

Admira Fusion is based on an organically modified ceramic, called Ormocer, with an inorganic base of silicon dioxide and polymerizable organic compounds, it combines the hardness of the glass with the properties of the resin. The optimal esthetics of this material claim to improve not only the aesthetics, but also the resistance to abrasion, allowing a decrease in the polymerization shrinkage and roughness of the surface, as well as protection against caries. Additionally, as it is BisGMA and any methacrylates-free, it avoids any type of concern related to cytotoxicity and estrogenicity, being considered inert and improving biocompatibility (28).

A very recent *in vitro* study on microleakage score in molar teeth after modification of the restoration protocol for resin-based composite restoratives both conventional and bulk fill, showed that teeth restored with Admira Fusion had significantly the lowest microleakage scores compared with other conventional and bulk fill restored teeth (29). On the other side, a study by Klauer E. et al., aimed to evaluate the mechanical stability of a Bis-GMA and Ormocer-based resin composites before and after water absorption, showed that the mechanical properties of the Bis-GMA composite were superior to those of the Ormocer®-based material, except water sorption (30).

This restorative technique for posterior segment direct reconstruction is recommended in cases where the occlusal plane is intact and preserved, due to hidden caries lesion. By using this procedure the operator will skip the following steps: (i) adjust the occlusal surface in respect to the opposing dental anatomy; ii) adjust/finish the margins for a smooth transition from tooth to restorative material; iii) create physiological anatomy and iv) smooth/polish the restored surface similar to natural tooth structure, which were mandatory if the traditional technique was used. This technique is time-saving and not-operator dependent and it might guarantee reproducibility of the results (32-34). Furthermore, this technique solves the curing problems associated with the oxygen-inhibited layer indirect composite restorations where oxygen, saturating superficial reactive



Figure 5. Post-treatment images, side and occlusal view.

sites, decreases the degree of polymerization of the most superficial layers (35).

Conclusions

Vistacam is an accurate, non-invasive method of assessing the advancement of an occlusal carious lesion. The ormocer-based material is easy and fast to handle and with an excellent esthetic outcome (Fig. 5), with high biocompatibility.

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