



Hidden caries: A critical review

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Abstract

Hidden caries is a type of lesion visualized in dentin, mainly by means of bitewing radiographs, in which, clinically, the occlusal enamel appears healthy or minimally demineralized and radiographically presents progressive demineralization in dentin, which may progress and compromise the pulp-dentin complex. Although the etiology of hidden caries is unknown, many theories have been studied, including structural and anatomical defects of enamel, their specific microbiota and the use of fluoride, which is most accepted theory. Considering the clinical concern, since these lesions have a silent progression and often are not detected on routine clinical examinations, this study aims to conduct a critical discussion of the etiology, prevalence, diagnostic methods and treatment decision for lesions of hidden caries, alerting professionals about the importance of routine use of bitewing radiographs even in patients considered “caries-free” or low risk of caries, for more effective diagnosis.

Introduction

According to the National Institute of Health, dental caries is defined as a transmissible infectious disease. It causes dental structure destruction by the constant exposition of the enamel and dentin to acids produced for bacteria present at the dental biofilm.^[1]

The diagnosis of the carious lesion presence can be categorized, according to the level of mineral loss, in subclinical lesions, lesions detectable only with complementary tests and clinically detectable lesions. The last ones can be subdivided in enamel lesions with or without cavity, dentin lesions with or without cavity and lesions that reached dental pulp.^[2]

The cavity sets in when the demineralized and without support enamel is broken due to progressive alteration of dentin. At this stage of the disease, neither the lesion can be inactivated, nor dental tissues may be remineralized. If no action is performed, the lesion progresses continuously until it compromises the dental pulp.^[3]

In 1986, the term hidden caries was proposed to describe an injury that completely differs from traditional development

of dental caries. In the hidden caries, it is observed the presence of dentin lesions over an enamel clinically healthy or minimally demineralized.^[4] Whereas the clinical signs of hidden caries indicate healthy dental structure or the presence of incipient enamel lesions, which can be inactivated and remineralized, radiographic signs of lesion in dentin indicate the need for immediate invasive restorative treatment. This unique feature creates many questions and challenges for clinical practice.^[5] Evidence of this is that the hidden caries diagnostic require radiographic procedures supplementation in situations that normally do not indicate the need of this exam, such as in occlusal surfaces of adult patients diagnosed as rigid teeth (International Caries Detection and Assessment System 00-ICDAS) or with minimum presence of enamel lesions (ICDAS 01 and 02).^[6]

According to Weerheijm *et al.* (1989),^[7] the hidden caries is a major problem for dentistry because of the difficulty in standardizing the diagnosis and consequently to establish a treatment plan and prevention. Thus, the aim of this study was to conduct a critical review of the etiology, prevalence, diagnostic methods and treatment decision for hidden caries.

Literature Review

Etiology

In 1986, Ball^[4] contextualized that the etiology of hidden caries was still unknown. Although, some theories were presented, such as the highly acidic feeding in teeth with fissures' deficient mineralization; the deep fissures and the anatomical complexity; the fluoride syndrome; the specific microbiota; the resorption of intracoronary dentin in the pre-eruptive phase and defect in the occlusal fissure.

Sawle, Andlaw^[8] (1988), confirmed the relationship of hidden caries and the use of fluoride. The most likely cause why the enamel cavitation feature on the occlusal surface is almost never present could be because fluoride increases the remineralization of occlusal enamel, delaying then the process of cavitation thereof.

Lussi^[9] (1993) also suggested that fluoride is responsible for changing the presentation of caries on the occlusal surface. According to the author, fluoride slows the development of enamel lesion by the well-known process of remineralization, which can mask the development of caries in dentin.

In 2000, Seow^[10] proposed that one of the hidden caries causes could be intracoronary dentine resorption during the pre-eruptive phase.

In addition, Lynch, Ten Cate^[11] (2006), investigated the interactions between enamel and dentin at low pH, simulating the enamel-dentin junction and concluded that the minerals lost by the dentin can be passed to the enamel, remineralizing it and leading to the hidden caries.

Prevalence

The prevalence of hidden caries is defined based on the comparison of the clinical appearance of the tooth, which should be rigid or with incipient enamel lesions and proven presence of lesions in dentin by interproximal or periapical radiographic findings.^[10] The first study on the subject was carried out by Allan, Naylor^[12] (1984), in which radiographs of 858 first molars were analyzed and it was found a prevalence of 22% of hidden caries.

Sawle, Andlaw^[8] (1988) found a low prevalence of hidden caries in the population, wherein the highest incidence were on the lower molars. In 1990, Creanor *et al.*^[13] Investigated the prevalence in 2623 individuals aged between 14 and 15 years old and found this type of lesion in 12.1% of the lower molars and 3.1% of the upper molars. Weerheijm *et al.*^[14] (1992) concluded that 15% of the teeth that showed no signs of enamel caries clinically presented dentin lesion radiographically, which represented 7.5% of the study population. Maltz *et al.*^[15] (1996) found hidden caries in only 2.2% of the analyzed molars.

Since 2000, there was an agreement among authors that when a blue and/or gray shadow is visible on the occlusal surface or marginal edge, both occlusal and proximal lesions are within the dentin.^[5,16] Then, it could be noticed that there was controversy about the diagnosis of dentinal lesions in apparently

intact enamel or with minimal interruption, because if on one hand there is a current that believes this type of lesion can be diagnosed only by radiographic examination, the so-called hidden caries, another side claims that all dentine lesion under non-cavitated enamel can be detected by the change of color and surface configuration. However, clinical evidence permits the inference that there are two situations, which makes it necessary to use different terminology for the distinction between the two entities.

In a study realized in Bahia, Arriaga^[17] (2001) observed a prevalence of 15.8% hidden caries among rigid molars. The study of Costa^[18] (2001), in Camaragibe-PE, found 10.5% prevalence. In 2008, Santos Junior *et al.*^[19] reported that among the 215 molars extracted evaluated in the study, 13% had this type of injury, especially the first molars. DeJean *et al.*^[20] (2009) observed that 42% of the teeth examined had hidden caries lesions, most commonly found in the lower first molar, showing the importance of the radiographic diagnostic in clinical practice.

Mota *et al.*^[21] (2011) conducted a study in order to differentiate, through photographs, the clinical features of the two entities of occlusal dentin lesions under enamel without cavitation: Clinically detectable lesion, proposing the terminology semioculta caries and the visible lesion only through radiographic examination, the hidden caries. This differentiation was very relevant, both for clinicians, in which it was possible to detect by detailed visual inspection, most dentin lesions in enamel without cavitation, and for researchers studying the prevalence of these lesions.

In 2012, Hashizume *et al.*,^[22] Realized a study to determine the prevalence of hidden caries in a group of children aged 8-10 years old in Porto Alegre-RS, before and after the use of fluoridated water and toothpaste. The authors found that students with access to fluoridated water and fluoride toothpastes had more occlusal surfaces considered rigid teeth in the first molars. The prevalence of hidden caries also decreased in 1996, indicating that the use of fluoride was not responsible for the appearance of hidden caries, unlike what had been reported by other authors.^[8,14]

Diagnostic methods

Weerheijm *et al.*^[23] (1997) Studied the use of clinical criteria of systematic detection and validated as the ICDAS, identifying carious lesions also in its early stages, in which are likely to remineralization or minimal intervention. In this classification code, 04 identifies the hidden caries (intact or slightly altered enamel surface and underlying lesion in dentin). However, the codes 1, 2 and 3 can also "hide" a hidden cavity. Similarly, although it is expected a direct relationship between high risk of caries and higher prevalence and severity of hidden caries, this still cannot be adequately proven.

Amore *et al.*^[24] (2000) studied and proposed some diagnostic methods, such as visual examination, conventional, digital or scanning radiographs, mechanical removal, fiber optic transillumination (FOTI), electric detector of carious

lesions, diode laser (Diagnodent), dyes, computer assisted by radiography, diode laser fluorescence, electrical conductance fixed frequency (ECFF) and high definition intraoral sensor (Visualix). The authors concluded that the most effective methods were clinical examination and X-rays, worked jointly.

In 2000, Ekstrand^[16] reported that the visual inspection and the radiographs are the most widely used techniques, wherein the first technique is based on the color changes and anatomical configuration of the tooth or examined surface.

According to Horowitz^[25] (2004), visual examination is often accompanied by the tactile analysis, with exploratory probe number 5. Due to evidence that a surface that undergoes demineralization may still be remineralized, forcing the tip of an explorer in a demineralized surface, still intact, can prevent the lesion to remineralize. The National Institute of Consensus in Health Diagnosis, Treatment and Control of caries concluded that the use of sharp probes for detection of dental caries adds little information to diagnosis and can be harmful.

In 2004, Ribeiro *et al.*^[26] concluded that interproximal radiographic technique is the most used in clinical practice for the presence of carious lesions, allowing an insight of all the structures of the enamel and periapical region, prioritizing the interproximal faces and bone crest. However, for this to be possible, it is necessary that the lesions have already evolved enough in dentin, which makes this an inappropriate method to detect lesions in their early stages, not enabling preventive remineralization methods to be adequately indicated.

Treatment

Hicks and Flaitz,^[27] in 1999, proposed the preventive resin restoration as the treatment of choice. This technique is based on filling the cavity with the resin and sealing the occlusal fissures, preventing thus bacterial colonization over the fissures and probably reducing leakage between the restoration and the tooth.

In 2005 Thompson *et al.*^[28] reported that, in a preventive manner, the dentist may consider the use of sealant in the fissures, which has proved effective in preventing hidden cavities.

From the moment that the hidden caries is detected, the dentist must take into account the importance of the patient's contribution, both in treatment and in the self-care measures, oral hygiene instruction, and dietary modification. Infinite treatments can be selected for each patient as fluoride varnishes, topical fluoride and chlorhexidine (Barnes, 2005).^[29]

Discussion

The literature about hidden caries is antique. In 1914, Black^[30] described it as a large cavity in which the gap remains small. Hyatt^[31] in 1931, reported it as a cavity that can advance very far along, starting from the base of a groove or fissure, leaving no clinical evidence.

Ball^[4] (1986) believes that the hidden caries is a result of routine and systematic use of fluoride, a practice that favors the remineralization of the enamel surface while the lesion

would progress in dentin. This hypothesis was called fluoride syndrome. However, Seow^[10] (2000) suppose that an "internal resorption" is the origin of such lesions. Given the assumptions of the authors, it is clear that so far there is no consensus on the actual etiology of hidden caries lesions.

There are also controversies about the relationship between the presence of hidden caries and the patients' caries risk. Although it is expected a direct relationship between high risk of caries and higher prevalence and severity of hidden caries, this still cannot be adequately proven.^[23]

It is verified a wide variation in prevalence data for this type of lesion. Creanor *et al.*^[20] Observed 0.8%, while Weerheijm *et al.*^[14] Found a prevalence of 50% among Scottish young adults. According to Santos Junior *et al.*^[19] (2008), such a divergence can be explained by differences in the populations studied, the clinical analysis methodologies and the radiographic evaluation employed. Nevertheless, it can be seen that there is a trend towards greater prevalence in older patients.

Although patients regularly attending the dentist and with improved financial condition have the main characteristics that favor the occurrence of the hidden caries-access to fluoride and absence or low occurrence of lesions occlusal caries-there is still no evidence of a relationship between socioeconomic status and prevalence of the same.^[32]

Amore *et al.*^[24] Agree that the best diagnosis of hidden caries is the association of visual examination with the radiographic. Visual inspection, or clinical examination should be done after removal of the biofilm, drying and proper lighting with reflector aid, as recommended by Weerheijm^[23] (1997), in order to obtain greater accuracy. Some clinical signs, such as opacity changes and pigmentations, can assist in suspected lesions in dentin.^[20]

Within the ICDAS classification criteria, the teeth that "hide" the hidden caries can be encoded at 00 (no change in translucency of enamel after drying for 5 s), 01 (visible opacity after drying for 5 s) and 02 (visible opacity even in the presence of moisture). When encoded with 04 (full or slightly altered enamel surface and shadow of the underlying dentin), there is very strong evidence of the presence of hidden caries.^[23]

The interproximal radiographic technique is the most used for the detection of caries, allowing an insight into all the dental structures, prioritizing the interproximal faces and the bone crest.^[26] Alternative methods for the diagnosis of caries such as FOTI, electrical impedance, laser fluorescence, use of dyes, ECFF have poor performance in the diagnosis of the presence of hidden caries.

Restorative treatment should always be based on the correct diagnosis of the lesion and the patient's risk of caries, in order to individualize treatment and increase the effectiveness. Based on it, we can decide for sealing, invasive sealing, minimally invasive restoration and composite resin or glass ionomer along with composite resin restorations.^[33]

Conclusion

It was concluded that, being a silent lesion, it is important early diagnosis of hidden caries lesions. Prevalence is high in young

adults, being this group considered at risk, requiring special care of the dentist, by performing detailed clinical examination and using bitewing radiographs. It should also be noted the importance of informing patients about this type of lesion, which can cause sensitivity, increased prevalence of caries, possible endodontic commitment and, in extreme cases, even tooth loss.

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