Title

Remote Caries Assessment with CariesCare International: Accuracy of Smartphone and Professional Camera Images

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Abstract

Objective: To evaluate the accuracy of remote caries lesion assessment using the CariesCare International (CCI) system applied to images captured with smartphones and professional cameras.

Methods: A cross-sectional study was conducted with 30 children aged 5–10 years, who underwent clinical dental examinations and intraoral photography using both a digital single-lens reflex (DSLR) camera and a smartphone. Trained examiners, blinded to the imaging devices, assessed the photographs and in-person examinations, with the latter serving as the gold standard. Statistical analyses included weighted kappa (κ_w) to evaluate inter-examiner reproducibility, along with sensitivity (Se), specificity (Sp), and area under the receiver operating characteristic curve (AUC) to determine detection accuracy.

Results: Inter-examiner reproducibility was excellent across all methods (K_w > 0.94). The professional camera demonstrated superior accuracy (Se = 0.87, Sp = 0.98; AUC = 0.92), with strong performance even for initial lesions (AUC = 0.88). Smartphone images showed good overall accuracy (Se = 0.73, Sp = 0.92, AUC = 0.83), performing particularly well for moderate and extensive lesions (AUC ≥ 0.87), and acceptably for initial lesions (AUC = 0.77). Both imaging methods achieved high specificity, reflecting accurate identification of sound surfaces.

Conclusions: These findings support the use of both professional and smartphone photography as effective tools for remote caries lesion assessment using the CariesCare International (CCI) system. Smartphone-based assessments represent a cost-effective and accessible alternative, especially in settings with limited resources. Integrating standardized systems like CCI into remote diagnostic workflows enhances diagnostic accuracy and can broaden access to dental care, helping reduce global oral health disparities.

Keywords: dental caries; photography, dental; remote consultation

Remote Caries Assessment with CariesCare International: Accuracy of Smartphone and Professional Camera Images

Dental caries is a highly prevalent, multifactorial disease that continues to pose a substantial global public health challenge due to its widespread occurrence and significant impact on affected individuals. According to the Global Burden of Disease Study, more than 2 billion people with permanent dentition are affected by dental caries,

and approximately 530 million children experience caries lesions in primary teeth, leading to considerable impairment in quality of life (Bernabe et al., 2020). If left untreated, caries lesions can result in severe pain, infection, and tooth loss, contributing to difficulties in eating, speaking, and overall well-being, with a disproportionate impact on marginalized populations (World Health Organization, 2022). Although preventable, dental caries remains especially prevalent in lower-income countries and communities, exacerbating existing health inequities (Pitts et al., 2017). As a global health issue, it requires increased attention, expanded prevention efforts, and accessible treatment options to mitigate its broad social and economic consequences (Bernabe et al., 2020; World Health Organization, 2022).

Accurate and reliable detection of dental caries is critical for ensuring proper management and improving oral health outcomes. Modern systems of caries detection and assessment emphasize the importance of identifying both early non-cavitated lesions and more advanced stages of the disease. The International Caries Detection and Assessment System (ICDAS), for instance, is designed to classify caries lesions based on visual examination, facilitating detection at the earliest stages while assessing lesion activity to predict progression or arrest (Pitts & Ekstrand, 2013). Additionally, CariesCare International (CCI), which is derived from the ICDAS and the International Caries Classification and Management System (ICCMS™), promotes a structured, patient-centered approach to caries assessment and management, emphasizing the identification of both initial non-cavitated lesions and advanced stages of decay (https://cariescareinternational.com/).

Epidemiological studies on dental caries commonly rely on large-scale oral health surveys that use standardized detection methods, such as the World Health Organization (WHO) oral health assessment protocol or ICDAS, to estimate caries prevalence (Estai et al., 2021). These studies provide valuable insights into population-level disease patterns

but face considerable logistical and financial challenges, particularly in reaching rural and underserved communities. Traditional face-to-face screenings, regarded as the gold standard for caries assessment, require significant resources, including trained dental professionals, travel to remote locations, and clinical equipment, making the process both time-consuming and costly (Estai et al., 2017). Additional barriers, such as the need for specialized tools and the expense of deploying healthcare providers, further limit the widespread implementation of these approaches (Estai et al., 2021). In response, alternative methods such as teledentistry and photographic screening have been explored as more accessible and cost-effective options. While these approaches show promise in reducing costs and overcoming geographic barriers, challenges related to diagnostic accuracy and image quality remain (Duong et al., 2021; Estai et al., 2016).

The use of photographs captured with professional cameras and smartphones is increasingly recognized as a valuable approach for assessing dental caries. In clinical settings, professional cameras have been used to obtain high-resolution intraoral images that support accurate detection of caries lesions, including early-stage lesions that may be overlooked during routine examinations (Estai et al., 2017). However, their high cost, bulk, and operational complexity often restrict their use to specialized environments (Estai et al., 2016). In contrast, smartphone cameras offer a more accessible and cost-effective alternative, delivering satisfactory image quality for remote caries assessment. Their portability and ease of use make smartphones a practical option for remote screening, enabling dental professionals to evaluate images submitted by patients or mid-level providers in geographically isolated areas (Estai et al., 2021). Research has shown that smartphone-based dental photography, when integrated into teledentistry platforms, can support the remote diagnosis and management of dental caries with acceptable diagnostic accuracy, particularly in resource-constrained and underserved populations (Nuvvula&Mallineni, 2021; Wallace et al., 2021).

Accurate detection of dental caries through photographic assessment remains a persistent challenge (Kargozar & Jadidfard, 2024). Although previous studies have demonstrated the potential of both professional cameras and smartphones for remote caries detection (Estai et al., 2017; Duong et al., 2021), a critical gap remains in integrating a comprehensive system like CCI to enhance diagnostic precision and caries management. CCI is a practice-oriented adaptation developed through international expert consensus to support its use in clinical settings (Ismail et al., 2015; Martignon et al., 2019). It provides not only diagnostic criteria but also a structured framework for evidence-based caries management, emphasizing early lesion detection and risk assessment to guide appropriate interventions (Martignon et al., 2019). This stands in contrast to traditional systems such as DMFT, which record only the presence or absence of decay and offer limited insight into lesion progression or care needs. By applying CCI, remote assessments can support more nuanced triage and intervention decisions, even in screening contexts, helping to tailor care strategies to lesion severity. Addressing this gap, our research contributes to the advancement of teledentistry, demonstrating how the use of CCI can improve the accuracy and clinical utility of remote caries assessment and management. This approach holds particular promise for improving clinical outcomes and supporting epidemiological research in settings where traditional face-to-face examinations are not feasible (Kargozar & Jadidfard, 2024; Pitts et al., 2021). Therefore, the objective of this study was to evaluate the diagnostic accuracy of dental caries assessment using photographs captured by both professional cameras and smartphones, assessed through the CCI system, with a particular focus on determining how accurately each method detects initial, moderate, and extensive lesions.

Method

Sample Size Calculation

Sample size was estimated using the power.roc.test() function from the *pROC* package in R, based on the formula proposed by Obuchowski et al. (2004) for assessing a single ROC curve against the null hypothesis of an area under the curve (AUC) of 0.5. The study was powered to detect an AUC of at least 0.70, a threshold considered acceptable for diagnostic accuracy (Hosmer et al., 2013), with 80% power and a two-sided alpha level of 0.05. Because lower disease prevalence requires larger sample sizes to achieve the same power, calculations were based on a minimum expected prevalence of 3%, reflecting the possibility of low frequency for specific caries lesion severities. The analysis indicated that a total of 536 surfaces would be needed, including 16 with caries lesions and 520 sound surfaces. As up to 36 surfaces per child would be evaluated, we determined that enrolling 30 children, resulting in a total of 1,080 potential surfaces, would be sufficient to meet these requirements while accounting for missing surfaces due to transitional gaps in the dentition of the children.

Participants and Procedure

Participants in this cross-sectional study were recruited by contacting the parents of children receiving dental care at the Universidad Iberoamericana Dental Clinic in Santo Domingo, Dominican Republic. As the clinic provides low-cost services, most participants came from low socioeconomic backgrounds and did not have dental insurance, making this a relevant population for evaluating teledental screening approaches in underserved or remote settings. Eligible participants were new patients between the ages of 5 and 10 years with no systemic diseases. This age range was selected because it represents a peak period of caries risk, involving both primary dentition and the eruption of first permanent molars, which are particularly susceptible to decay (Abreu et al., 2019; Bernabe et al., 2020; Martignon et al., 2021). Children in this group are typically cooperative during examinations and are unlikely to wear orthodontic appliances that could obstruct visualization of tooth surfaces in photographs. A convenience sample of

30 eligible children was selected. The study was approved by the Research Ethics Committee of Universidad Iberoamericana (CEI2020-36). Parents received detailed information about the study, and both parental consent and child assent were obtained. Clinical photographs were taken first, followed by a comprehensive oral examination.

Clinical Examination

Before conducting the oral evaluations, examiners received comprehensive training to standardize the photographic protocol using both a professional camera and a smartphone. This training addressed the technical operation of each device and established specific guidelines to ensure consistent image quality across participants. One examiner was assigned to capture images with the professional camera, while the other used the smartphone. In addition, both examiners underwent thorough instruction in the detection of dental caries lesions using CCI criteria. To reinforce consistency, they also conducted practice sessions on extracted teeth, ensuring uniform application of the CCI guidelines during caries detection.

(1) A professional digital single-lens reflex (DSLR) camera (Canon EOS Rebel T5) equipped with a 100 mm macro lens and a Yongnuo ring flash. The camera operated in manual mode (M) with settings configured as ISO 200, aperture f/25, and shutter speed 1/100. The ring flash was calibrated to a power setting of 1:1.

(2) An iPhone 11 Pro Max smartphone paired with an Auxwila LED ring light. The smartphone camera functioned with automatic settings, and the LED ring light was set to its lowest illumination level.

Before the in-person examination, participants were seated in a well-illuminated dental chair. Parents were instructed to ensure that their children had brushed their teeth using a toothbrush and fluoride toothpaste. If supragingival tartar was present, scaling was performed with a jaquette on the affected areas. A basic clinical examination kit,

including a WHO probe, was used for the in-person assessments. Tooth surfaces were dried with cotton rolls to reduce moisture and allow for clear visual inspection. This approach aligns with adaptations of the CariesCare International (CCI) protocol in field conditions, such as the multicentre Caries OUT study, where cotton rolls and gauze were used to achieve standardized assessments without the use of pressurized air or clinical equipment (Martignon et al., 2021). Oral evaluations were then conducted using the CCI criteria for caries detection and assessment. The following codes were applied: sound surface (code 0), initial lesion (code 1), moderate lesion (code 2), and extensive lesion (code 3) (Martignon et al., 2019; Martignon et al., 2021) (see Table 1).

PLEASE INSERT TABLE 1 ABOUT HERE

After the clinical examination, participants remained seated for the photographic documentation, which was completed using both devices (Figures 1 and 2). Lip retractors were used to enhance the visibility of the oral cavity. Photographs were taken from frontal, right lateral, left lateral, upper occlusal, and lower occlusal views (without the use of an intraoral mirror). For the smartphone images, a predetermined distance was maintained by using an open hand as a guide to ensure consistent positioning of the device relative to the patient's mouth.

PLEASE INSERT FIGURE 1 ABOUT HERE

PLEASE INSERT FIGURE 2 ABOUT HERE

Assessment of Caries Lesions Using Photographs

A dentist trained in the CCI criteria and blinded to the imaging devices evaluated the photographs captured with both the professional camera and the smartphone. For each image set, the buccal and occlusal surfaces of the visible teeth were carefully assessed. Only these surfaces were included, as they are most frequently affected by dental caries in children and can be reliably evaluated through visual inspection and photographic

analysis. In contrast, lingual and palatal surfaces exhibit lower caries prevalence, and proximal surfaces are more difficult to assess without radiographic support (Cortés et al., 2018). The examiner received an Excel file with patient-specific information, including patient number, age, and sex, along with the tooth number and surface to be assessed. A corresponding folder of photographs was also provided, organized by patient number and labeled according to view: frontal, right lateral, left lateral, upper occlusal, and lower occlusal. Importantly, the examiner was not informed of which device had been used to capture each image

To preserve the integrity of the blinding, the examiner reviewed two sets of images: the "A" file on one day and the "B" file five days later. Both sets were randomized to conceal the imaging device used. The examiner assessed the images on a computer, while a separate individual managed file organization and data handling to ensure blinding and maintain data integrity

Inter-examiner Reproducibility

The study involved four examiners: two conducted clinical evaluations and two assessed photographs. One examiner from each pair evaluated all participants, while the second examiner assessed a subset to measure inter-examiner reproducibility. Examiner 1 performed the clinical examinations for all participants, and these findings served as the reference standard. Examiner 2 conducted clinical examinations on a subset of three participants, and this subset was used to calculate inter-examiner reproducibility. Examiner 3 received an initial randomized set of images consisting of five photographs per participant, taken either with the professional camera or the smartphone. Five days later, Examiner 3 evaluated a second randomized set of images from the same participants, with each image captured using the alternate device. If the first set included

a professional camera image for a participant, the second set included the corresponding smartphone image, and vice versa. Examiner 4 assessed photographs from three participants whose images were captured with the professional camera and three different participants whose images were captured with the smartphone; these evaluations were used to further assess inter-examiner reproducibility in the photographic assessments.

Statistical Analyses

Inter-examiner reproducibility of CCI dental caries scores was assessed using the weighted kappa statistic with the quadratic method (K_w), which is recommended for ordinal data (Mendes et al., 2010). These analyses were conducted separately for each mode of clinical examination: in-person, professional camera photographs, and smartphone photographs. In addition, K_w was used to evaluate agreement in CCI dental caries lesion scores across the different examination modes. Kappa values were interpreted according to established benchmarks (Landis & Koch, 1997): 0.00–0.20 as poor agreement, 0.21–0.40 as fair, 0.41–0.60 as moderate, 0.61–0.80 as substantial, and 0.81 or higher as excellent agreement.

Detection accuracy for both professional camera and smartphone assessments was further evaluated using sensitivity (Se), specificity (Sp), and the area under the receiver operating characteristic curve (AUC). For these analyses, in-person caries lesion scores served as the gold standard, and CCI values were dichotomized separately for each lesion stage and for all lesions combined: sound surfaces (CCI = 0) were coded as 0, while initial (CCI = 1), moderate (CCI = 2), and extensive lesions (CCI = 3) were each coded as 1 in separate diagnostic accuracy analyses; for the combined analysis, all carious surfaces (CCI>0) were coded as 1. Recommended performance thresholds for caries detection methods include a sensitivity of at least 0.75 and a specificity of at least

0.85 (Xing et al., 2021). AUC values were interpreted as follows (Hosmer et al., 2013): ≥ 0.90 as outstanding, 0.80–0.89 as excellent, 0.70–0.79 as acceptable, and 0.50–0.69 as poor. All data processing and statistical analyses were conducted using IBM SPSS Statistics (Version 25).

Results

The sample included 30 children aged 5 to 10 years (M = 6.7, SD = 1.5), with equal distribution by sex (50% female, 50% male). For each participant, the buccal and occlusal surfaces of the molars (primary and permanent) and erupted premolars were selected for evaluation. The buccal surfaces of all present primary and permanent incisors were also included. Permanent canines and second and third permanent molars were excluded, as they were expected to be unerupted given the participants' age. Each child contributed up to 36 assessable surfaces across 24 teeth, yielding 1,080 potential surfaces for the study. Of these, 873 were evaluated, with 19.2% missing. The primary reason for missing data was the presence of transitional gaps in dentition, where the primary tooth had exfoliated and/or the permanent teeth had not yet erupted. This was most common in the first permanent molars, which had 48.8% missing surfaces. In contrast, lower rates were observed for primary molars (11.0%), primary canines (11.7%), and incisors (9.6%). All clinically examined surfaces were successfully assessed in the images from both the professional camera and the smartphone, with no exclusions due to image quality.

Inter-examiner reproducibility of CCI dental caries lesion scores was excellent across all three modes of assessment. In each case, two certified examiners independently evaluated three children using the same criteria. Agreement was highest for professional camera images (κ_w = 0.99, p < .001; 83 surfaces), followed by in-person examination (κ_w = 0.96, p < .001; 88 surfaces) and smartphone images (κ_w = 0.94, p < .001; 92 surfaces).

The distribution of CCI scores across the three examination modes (in-person, professional camera, and smartphone) revealed consistent patterns (see Figure 3). Most surfaces were classified as score 0, indicating no visible caries lesions, with proportions of 61.4%, 65.4%, and 66.9% for in-person, professional camera, and smartphone assessments, respectively. Initial lesions (score 1) showed similar frequencies across modes, ranging from 18.6% (smartphone) to 23.5% (in-person). Moderate (score 2) and extensive lesions (score 3) were less common, each representing fewer than 6.0% and 11.0% of surfaces, respectively, in all modes. While some variation was observed, all examination methods consistently classified the majority of surfaces in the lower CCI score categories.

PLEASE INSERT FIGURE 3 ABOUT HERE

Table 2 presents the detection accuracy of caries assessments using professional camera and smartphone images across the three levels of lesion severity and overall. Accuracy was calculated using in-person CCI scores as the reference standard. Sensitivity, specificity, and AUC were used to evaluate detection performance.

PLEASE INSERT TABLE 2 ABOUT HERE

Specificity, reflecting the correct identification of sound surfaces, was high for both professional camera (Sp = 0.98) and smartphone assessments (Sp = 0.92), exceeding the recommended threshold of 0.85. For extensive caries lesions, both methods showed excellent detection accuracy, with high sensitivity (Se $\geq$ 0.98) and AUC values in the outstanding range (AUC $\geq$ 0.95), indicating near-perfect performance. For moderate lesions, both methods demonstrated acceptable to excellent sensitivity, with the professional camera (Se = 0.98) again outperforming the smartphone (Se = 0.81). AUC values remained within the excellent to outstanding range for both devices (AUC $\geq$

0.87), indicating reliable detection despite a modest reduction in sensitivity compared to extensive lesions. For initial lesions, sensitivity declined in both devices. The professional camera maintained better performance, slightly exceeding the 0.75 threshold (Se = 0.79), while the smartphone fell below this level (Se = 0.61), highlighting its reduced effectiveness in detecting early caries. Nonetheless, the smartphone achieved an acceptable AUC for initial lesions (AUC = 0.77), whereas the professional camera reached an excellent level of detection (AUC = 0.88). Overall, detection accuracy across all surfaces was strong, with the professional camera consistently surpassing the recommended thresholds for sensitivity and specificity, and the smartphone closely approaching or exceeding these benchmarks.

Discussion

Main Findings

This study highlights the accuracy of dental caries assessment using images captured with both professional cameras and smartphones within the CCI system. The findings show that both methods are effective for remote assessment and represent practical alternatives to in-person evaluation. As expected, professional cameras performed better overall, especially for early caries lesions, likely because of their enhanced image quality (Estai et al., 2017; Kohara et al., 2018). A key contribution of this study, however, is the finding that smartphone images also offer a viable alternative for remote assessment, performing particularly well in the detection of moderate and extensive lesions. These results are in line with a growing body of evidence supporting the use of both professional and smartphone imaging technologies in teledentistry (Estai et al., 2017; Kargozar & Jadidfard, 2024; Kohara et al., 2018).

Although smartphones exhibited lower sensitivity than professional cameras in detecting initial caries lesions, their performance still met clinically acceptable standards. Combined with high specificity, this resulted in satisfactory accuracy for early dental caries detection. While previous studies had raised concerns regarding the diagnostic limitations of smartphones, particularly for initial caries lesions (Estai et al., 2017; Kohara et al., 2018; Kargozar&Jadidfard, 2024), our findings provide novel evidence that they can achieve acceptable performance, significantly broadening their potential utility in teledentistry (Estai et al., 2017; Walsh et al., 2021). These outcomes are particularly valuable in resource-limited settings, where professional imaging equipment may be scarce. Smartphones offer a cost-effective, accessible alternative, enabling remote caries assessment in underserved areas. Moreover, although smartphone cameras currently fall short of professional devices in capturing some subtle visual cues important for early dental caries detection, rapid advancements in mobile imaging technology are quickly narrowing this gap.

A key contribution of this study is the integration of the CCI system, which focuses on early lesion detection and comprehensive caries management, into teledentistry using both professional and smartphone images. This represents a significant advancement in standardizing remote caries assessment, as the CCI system has traditionally been applied in clinical settings to guide patient care through a structured, evidence-based framework (Martignon et al., 2019). By applying CCI to remote imaging modalities, our study enhances diagnostic precision and consistency, addressing previous concerns about variability in diagnostic outcomes when teledentistry lacked such standardized protocols (Walsh et al., 2021). Whereas traditional systems such as DMFT allow only a binary classification of surfaces as "decayed" or "sound," limiting sensitivity and specificity analyses to the presence or absence of lesions, the CCI system distinguishes lesion severity into clinically meaningful stages. In this study, we calculated sensitivity and

specificity not only by grouping all lesions together but also separately for initial, moderate, and extensive caries lesions. This provided a more detailed understanding of detection performance across lesion stages, essential for optimizing preventive care strategies and ensuring timely intervention in remote screening contexts.

While teledentistry is often associated with binary screening, the ability to distinguish among stages of caries lesion severity within the CCI framework adds substantial clinical and public health value. Initial lesions can often be arrested through at-home care, including fluoride toothpaste use, dietary modifications, interproximal cleaning, and behavioral guidance delivered remotely. Moderate lesions, particularly micro-cavitated ones without dentin exposure, may also be managed remotely through non-operative care but require closer monitoring, reinforced hygiene instructions, and sustained behavioral support. In contrast, extensive lesions typically necessitate immediate in-person operative care. Thus, distinguishing lesion stages remotely is essential not only for prioritizing care but also for delivering stage-appropriate interventions that optimize outcomes and resource use, especially in settings with limited dental access.

Limitations and Future Directions

Despite the promising results, this study has limitations that warrant consideration. The controlled clinical environment, with standardized lighting and image capture procedures, may not accurately reflect real-world conditions. In less controlled settings (such as community clinics, homes, schools, or rural healthcare facilities) variations in lighting, image capture angles, and patient compliance could adversely affect image quality and, consequently, detection accuracy for both professional cameras and smartphones (Kargozar & Jadidfard, 2024). Future research should investigate the feasibility and effectiveness of training non-dental professionals, including patients and

community health workers, to consistently acquire high-quality images in these settings. It should also explore how differences in devices and lighting equipment may impact image quality and diagnostic accuracy across a range of field conditions. Furthermore, while the study established the diagnostic potential of remote photographic assessments, it did not evaluate the longitudinal impact on caries management outcomes. Prospective studies should examine whether early detection facilitated by teledentistry translates into improved clinical outcomes, such as decreased caries progression and a reduced need for invasive restorative procedures over time. Additionally, future research should prioritize the advancement of methods for detecting proximal lesions through photographic analysis to enhance diagnostic accuracy and preventive care.

Practical Implications

The present findings highlight the potential of teledentistry to expand access to dental care through the strategic integration of professional cameras and smartphones. Professional cameras, with their high image quality and sensitivity, support remote diagnostics that closely replicate traditional evaluations, enabling accurate caries detection across all stages, ultimately improving patient outcomes. Smartphone cameras, meanwhile, provide a more accessible alternative without substantial loss in diagnostic accuracy, making them effective for detecting lesions suitable for non-operative interventions. This dual approach can reduce healthcare disparities by facilitating early detection in underserved areas, particularly when combined with the standardized caries risk assessment and management framework provided by the CCI system (Estai et al., 2021; Fricton & Chen, 2009; Martignon et al., 2019). By employing professional cameras in adequately resourced settings and smartphones in resource-limited areas, this integrative strategy aligns with global health goals to improve preventive care and lessen the global burden of untreated dental caries (World Health Organization, 2022). Together,

high-quality imaging and accessible technology within the CCI system allow teledentistry to address oral health disparities, delivering timely and effective dental care to broader populations (Kargozar&Jadidfard, 2024)

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Figure 1

Procedure for Capturing Images Using a Professional Camera and a Smartphone

Figure 2

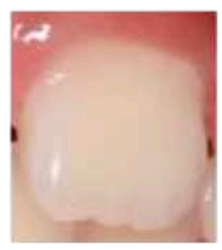
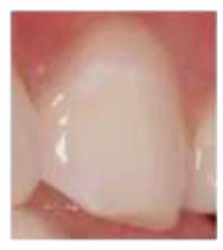
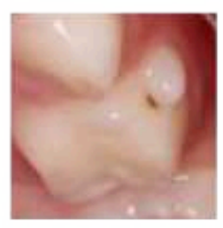
Intraoral Images Captured with a Professional Camera and Smartphone

Figure 3

Frequency Distributions of the CCI Dental Caries Scores Across the Modes of Examination

Table 1

Description of Caries Lesion Stages According to CariesCare International

CCI visual coronal caries lesion stages		
Sound (0)	No evidence of change in enamel translucency due to demineralization in plaque retention sites after professional cleaning and air-drying.	
Initial caries lesions (1)	Changes in enamel translucency seen as a carious opacity or visible discoloration (white/brown spot).	
Moderate caries lesions (2)	White/brown spot lesion with localized micro-cavity/discontinuity, without visible dentine exposure. Obviously discolored dentine visible through apparently intact or micro-cavitated enamel surface, which originated on the surface being evaluated.	 
Extensive caries lesions (3)	Obvious visible dentine cavity in opaque/discoloured enamel.	

Adapted from Martignon et al., 2019

Table 2

Detection Accuracy of Dental Caries Lesions with Professional Camera and Smartphone Photos

Caries	Surface Type		Professional Camera			Smartphone		
Lesions	Sound	Carious	Se	Sp	AUC	Se	Sp	AUC
CCI=3	536	89	1.00	0.98	0.99	0.98	0.92	0.95
CCI=2	536	43	0.98	0.98	0.98	0.81	0.92	0.87
CCI=1	536	205	0.79	0.98	0.88	0.61	0.92	0.77
All	536	337	0.87	0.98	0.92	0.73	0.92	0.83

Note. CCI = CariesCare International; Se = sensitivity; Sp = specificity; AUC = area under the receiver operating characteristic (ROC) curve. $p < .001$ for all AUCs.