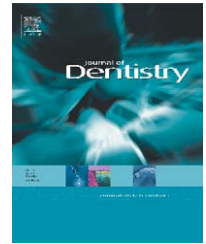


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A comparison of root caries diagnosis based on visual-tactile criteria and DIAGNOdent in vivo[☆]

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ABSTRACT

Objectives: This clinical study aimed to evaluate the validity of using DIAGNOdent in diagnosing root caries, and to assess the sensitivity and specificity of different cut-off DIAGNOdent values in assessing root caries with reference to visual-tactile criteria.

Methods: Exposed root surfaces were assessed by one examiner for root caries on 266 subjects using visual-tactile criteria and DIAGNOdent 2095 after dental scaling. Associations between DIAGNOdent values and visual-tactile diagnosis of root caries were determined. The cut-off level for statistical significance was 0.05. The sensitivity and specificity of DIAGNOdent with difference cut-off points were analysed compared to visual-tactile diagnosis of root caries.

Results: There was significant difference between DIAGNOdent values obtained from sound and carious root surfaces ($p < 0.001$). On carious surfaces, active root caries obtained significantly higher DIAGNOdent values than inactive root caries ($p < 0.001$). With increasing cut-off point DIAGNOdent values from 5 to 35, sensitivity decreased from 91.4% to 16.2% and specificity increased from 64.4% to 98.2%. A cut-off point of DIAGNOdent value between 5 and 10 produced the highest combined sensitivity and specificity.

Conclusions: There was a significant difference in DIAGNOdent values between sound and carious root surfaces diagnosed by visual-tactile criteria supporting the validity of DIAGNOdent for assessing root caries. A DIAGNOdent value between 5 and 10 produced the highest combined sensitivity and specificity when visual-tactile assessment of root caries was regarded as the criterion. These findings have implications in using and explaining DIAGNOdent values in assessing root caries.

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1. Introduction

Root caries is commonly defined as a soft, irregularly shaped, dark coloured, chronic progressive lesion either totally confined to the root surface or involving the undermining of cementum, enamel and dentine at the cemento-enamel junction, but clinically indicating that the lesion initiated on

the root surface.^{1–3} Recession of the gingival margin, resulting from poor oral hygiene and loss of periodontal attachment with age, leads to exposure of the juncture of the crown with the root surface. This area retains dental plaque and is prone to developing carious lesions. It is a major dental disease among older people because root surfaces are usually exposed and this increases their risk to root caries.⁴ Root caries has

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become a significant public health problem for older population as the proportion and actual number of older people has increased. The prevalence of primary root caries globally among older people (aged 60 and older) is estimated to be around 10–40%.^{4–7} When secondary root caries and filled surfaces are considered, the prevalence of root caries is estimated to be higher. Globally the mean number of decayed root surfaces among older people is reported to be between 0.4 and 5.3.

Traditionally visual-tactile assessment of root caries has been conducted in establishing a diagnosis for root caries.^{1,2} However, visual-tactile assessment is of limited use in the diagnosis of early root caries lesions. Early root caries involving cementum alone cannot be detected clinically.^{2,3} However bacteria can penetrate into the tissue at an earlier stage of lesion development. Diagnosis of early/incipient root caries is of paramount importance in arresting and reversing early root caries and thus detecting early root caries remains a key challenge for researchers and clinicians.

In recent times great advances have been made in detecting root caries with the aid of laser fluorescence techniques. DIAGNOdent (DD), a laser fluorescence instrument has proved useful in the diagnosis of occlusal and smooth surfaces caries.^{8,9} It has been shown that discoloured root surfaces had distinctly different fluorescence emissions compared to sound root surface.¹⁰ Moreover, it has been shown that reproducible readings can be obtained by DD from root surfaces *in vitro*.¹¹ DD could be helpful in diagnosing root caries. A significant omission in the literature to date is how DD values compare with visual-tactile assessment of root caries *in vivo* and how to interpret DD values in the context of root caries.

This clinical study aimed to determine the association between DD values and visual-tactile assessment of root caries. In addition, to assess the sensitivity and specificity of different cut-off DD values in the assessment of root caries with reference to visual-tactile criteria.

2. Materials and methods

2.1. Subjects and study design

A screening for root caries was conducted among 717 adults (aged 60 and older) at eleven communities in Hong Kong. Subjects who had at least five exposed root surfaces and no serious systematic disease were invited to undergo a comprehensive root caries assessment in a clinical setting (266 subjects). All subjects received a dental scaling to remove visible plaque and calculus by a dental hygienist before the root caries assessment.

2.2. Ethics

Ethical approval was obtained from the Institutional Review Board of The University of Hong Kong/Hong Kong Hospital Authority for this study as part of a clinical trial. All subjects provided their informed consent prior to the commencement of oral examinations in the clinical setting.

Table 1 – Clinical criteria and description of root surfaces.

Visual-tactile criteria	Description
Sound	Normal texture, no colour change, non-cavitated
Caries	
Active caries	Yellowish or light brownish, and soft on light probing
Inactive caries	Darkly discoloured, black, smooth and hard on light probing

2.3. Visual-tactile root surface assessment

A sickle-shaped caries probe was used to confirm the presence of soft decayed tooth tissues located either wholly on the root surface or at the cemento-enamel junction on the basis of appearance showing surface tissue loss and/or a colour change. If a caries lesion involved both the tooth root and the tooth crown, judgment on its origin was made, based on its location and extension. When more than half of a lesion was located on the root surface, it was considered as originating from the root surface and recorded as root caries. If the carious root surface is discrete from the crown and will require a separated treatment, it should be recorded as root caries. When it is not possible to judge the site of origin, both the crown and the root should be recorded as decayed.¹² Visual-tactile criteria were used to distinguish active and inactive root caries (Table 1). All assessment was performed by a trained and calibrated dentist.

2.4. Laser fluorescence assessment

The laser fluorescence measurement was made with the DIAGNOdent 2095 (KaVo, Biberach, Germany), Fig. 1. At the start of each clinical session the device was calibrated according to the user's manual. The exposed buccal and lingual root surfaces of teeth were measured by DD using a type A tip. The possible value of DD was from 0 to 99 and the maximum reading on each exposed root surface was recorded. All laser fluorescent assessments were performed by a trained and calibrated dentist masked of visual-tactile root surface assessments. Duplicate assessments were



Fig. 1 – DIAGNOdent 2095.

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