

LASER FLUORESCENCE DEVICE (DIAGNODENT) IN COMPARISON TO VISUAL EXAMINATION IN DETECTION OF OCCLUSAL CARIES IN PERMANENT MOLARS AND PREMOLARS

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ABSTRACT

The objective of this study was to evaluate and compare laser fluorescence (LF), using DIAGNODent tool and visual examination (VE) methods for diagnosis of early occlusal caries in permanent molars and premolars. Two hundred occlusal surfaces were randomly selected in permanent molars and premolars of 54 female patients (17-25 years old), visited Dental Hygiene Clinics of College of Dentistry, King Saud University, Riyadh, Saudi Arabia. Clinical examination for dental caries using LF and VE methods was conducted by two examiners. The agreement between the two examiners was almost perfect (Kappa .87 and 1.0) using LF and VE for diagnosis of the occlusal caries. There was no significant difference in sensitivity and specificity value of the two methods. It is also concluded that the laser fluorescence can be used as an adjunct tool in the diagnosis of occlusal dental caries in permanent molars and premolars.

Key Words: Occlusal caries, permanent molars & premolars, laser fluorescence (DIAGNODent)

INTRODUCTION

Dental caries is highly prevalent among Saudis, and the prevalence is expected to increase further in primary and permanent teeth.¹ Early detection of this disease would enable dentists to execute non/minimally invasive treatment that could be less expensive for the patient and also provide considerable improvement in the tooth's life span.

Occlusal surfaces are difficult to detect on clinical examination, due to occlusal anatomy (pits and fissures) especially in premolars and molars that cannot be easily cleansed from deposit and debris. Similarly, it is not easy to detect depth or progress of initial and recurrent caries by conventional visual and tactile methods of caries detection. Bitewing radiographs used for proximal caries detection may not be useful for detection of occlusal caries due to overlapping structures. As stated in evidence-based literature, sharp dental explorer is an inappropriate tool for assessing dental lesions because they can irreversibly damage enamel.^{2,8} Pit and fissures dental caries usually spread in inverted "V" pattern with broad surface towards dentino-enamel junction

(DEJ). Smooth surface caries spread is V-shaped with the apex towards DEJ. Therefore, occlusal caries has greater tendency reaching pulp if not detected at an early stage. Visual examination is basically a direct, and there is difficulty in assessing the severity of occlusal caries.^{9,10} Many studies have documented false-positive and false-negative findings frequently encountered during detection of occlusal caries with VE.^{11,13}

With advancement in technology, caries detection devices that help in identifying early carious lesions are now available. The Laser fluorescence (LF) device (DIAGNODent) was introduced in market in 1998, as a tool to help in diagnosis of early occlusal caries as an adjunct to visual examination. The device is based on the principle that when an infrared laser with 655 nm wavelength is irradiated on dental surface, light is absorbed by tooth tissues as well as by metabolites from oral bacterial porphyrins¹⁴, and in this way, decalcified areas in the enamel and dentin structure stimulate fluorescent light of a different wavelength, and resulting fluorescence is evaluated by the appropriate electronic system in the DIAGNODent unit. The information is scarce on comparing the performance of DIAGNODent LF device with visual examination (VE) in detection of occlusal caries in the Saudi population. The aim of this study therefore, was to compare efficacy of LF and VE methods for detection of occlusal caries in permanent molars and premolars.

MATERIALS AND METHODS

Two hundred occlusal surfaces were randomly se-

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lected in permanent molars and premolars of 54 female patients (age 17-25 years) attending Dental Hygiene Clinics of College of Dentistry, King Saud University, Riyadh, Saudi Arabia. All the patients had unremarkable medical history. All restored, extensively carious, and structurally defective teeth were excluded. The inclusion criteria were; sound, initial visual changes, distinct visual changes, opacity or discoloration or enamel caries on the occlusal surfaces.

After taking consent from the selected patients, the procedure was explained to the patients. Visual clinical examination was carried out by two experienced examiners (KP & SM) with dental light, air/water spray and mouth mirror. Loose debris were removed by water sprays and surfaces dried with air without using any probe. The visual clinical examination followed criteria provided by Ekstrand et al. (1998)⁴ [Table 1]. The LF examination using DIAGNOdent (KaVo, Germany, Pen 2190) was carried out by same two examiners using criteria (0-100) provided by Lussi et al (1991)⁸ [Table 2]. The measurements were taken by using a fiber-optic conical tip (Tip A) specifically designed for occlusal surfaces according to the manufacturer's instructions. The highest reading shown on the device was recorded. All readings were recorded on a form especially designed for the study.

The data were entered into a computer and analyzed using Statistical Package for Social Sciences (SPSS) version #17. Intra- and inter-examiner agreements for both VE and LF methods were assessed using kappa statistics. Chi-square test was used to compare all categorical data.

RESULTS

Distribution of 200 selected occlusal surfaces in molars and premolars is given in Table 3; with almost even distribution in terms of tooth type (Table 3). The results of VE for occlusal caries by the two examiners are detailed in Table 4. There was almost perfect agreement (Kappa value .87) found between two examiners in diagnosing occlusal caries by VE. The results of examination for occlusal caries using LF by the two examiners are describe in Table 5. There was a perfect agreement (Kappa value 1) found between the two examiners using LF in detection of occlusal caries in permanent molars and premolars.

The diagnosis of occlusal surface caries by the VE and LF methods was significantly ($p=.003$) similar (Figure 1). The sensitivity for both the methods (VE=.87 and LF=.9) was much higher than specificity (VE=.5 and LF=.5) [Table 6]. The specificity scores were same for both visual and LF methods, while sensitivity score was slightly high for LF method than VE method (Table 6).

DISCUSSION

The occlusal surface of tooth is more susceptible to dental caries and reliable detection of occlusal caries is a challenging task. Early caries detection improves the chances of successful prevention strategies. The results of this study showed that LF (DIAGNOdent 2190) is a sensitive method in early detection of occlusal caries, and LF method could be used as an adjunct tool followed by VE method. Zaidi et al (2016)¹⁸ conducted an in-vivo study on deciduous and permanent teeth, their results were in agreement with this study.

They concluded that the DIAGNOdent was the most accurate and valid system tested for the detection of occlusal caries. They found a higher value of sensitivity for DIAGNOdent (0.91) than for visual examination. They observed that DIAGNOdent has the advantage of quantifying the mineral content of the teeth and visual examination alone is not adequate.

Kouchaji (2012)¹⁹ showed a strong relationship

TABLE 1: VISUAL CLINICAL EXAMINATION (VE) CRITERIA BY EKSTRAND ET AL.15

Score	Criteria
0	No or slight change in enamel translucency after prolonged air-drying
1	Opacity or discoloration hardly visible without drying, but visible after air-drying
2	Opacity or discoloration visible even without air-drying
3	Localized enamel breakdown in opaque or discolored enamel and / or grayish discoloration from underlying dentin
4	Cavitation in plaque or discolored enamel exposing to dentin

TABLE 2: CRITERIA USED IN EXAMINATION WITH DIAGNODENT BY LUSSI ET AL.16

Score	Criteria
0-14	No caries
15-20	Enamel caries
21-99	Dentinal caries

TABLE 3: DISTRIBUTION OF EXAMINED OCCLUSAL SURFACES

Total surfaces	Teeth	No of surfaces	Percentage %
200	Premolars	101	50.5
	Molars	99	49.5
	Total	200	100

TABLE 4: VISUAL EXAMINATION BY THE TWO EXAMINERS FOR OCCLUSAL CARIES

Stage of decay	Ex 1	Percentage	Ex 2	Percentage	Kappa Value
No caries	25	12.5%	21	10.5%	0.872
Opacity after air-drying	75	37.5%	79	39.5%	
Opacity visible without air-drying	44	22%	44	22%	
Localized enamel breakdown	46	23%	41	20.5%	
Cavity	10	5%	15	7.5%	
Total	200	100	200	100	

Ex= Examiner

TABLE 5: EXAMINATION BY THE TWO EXAMINERS FOR OCCLUSAL CARIES USING LF METHOD

Stage of decay	Ex 1	Percentage	Ex 2	Percentage	Kappa
0-14 (no caries)	21	10.5%	21	11.5%	1.000
15-20 (enamel)	43	21.5%	43	21%	
21-99 (dentinal caries)	136	68%	136	67.5%	
Total	200	100%	200	100%	

Ex= Examiner

TABLE 6: SPECIFICITY AND SENSITIVITY

Methods	No Caries	Caries	Caries status		Specificity	Sensitivity
			Caries free	Caries		
Visual	25	175	12.5%	87.5%	0.50	0.875
DD	20	180	10%	90%	0.50	0.900

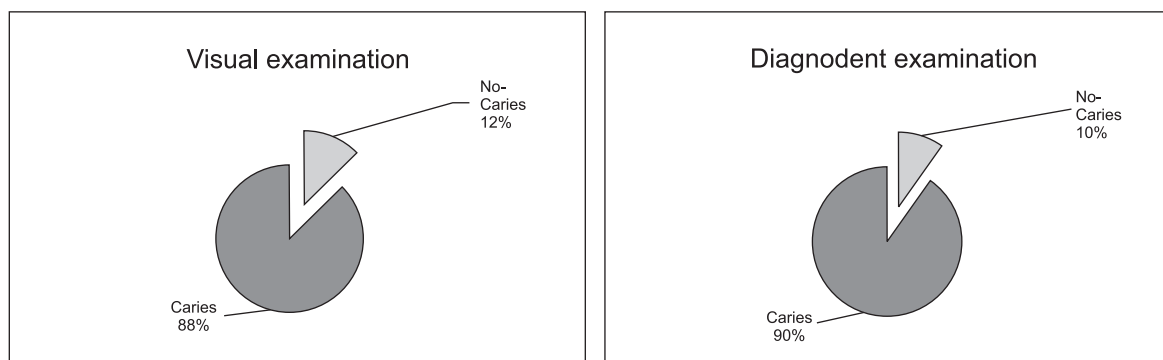


Fig 1: Comparison of caries diagnosis by VE and LF (DIAGNOdent)

between examination with the DIAGNOdent and VE. DIAGNOdent sensitivity and specificity were .97 and .52, respectively. He concluded that DIAGNOdent may be very helpful in conjunction with visual examination in the detection of occlusal caries in permanent molars of children. In 2005, Melo et al²⁰ conducted a prospective study in Spain compared traditional visual and tactile method, DIAGNOdent, Vista Proof and Caries Scan for diagnosis of occlusal caries. DIAGNOdent was seen to be the most effective technique followed by Caries Scan and Vista Proof. Attrill & Ashley (2001)¹⁷ compared VE

and LF methods; and found higher sensitivity for DIAGNOdent (0.77 and 0.80) among two examiners. They concluded that DIAGNOdent was the most accurate system tested for detection of occlusal caries in primary molars. They also mentioned that the performance of LF system was not statistically better than the visual examination of non-cavitated teeth. In 2005 Angnes et al²¹ compared the performance of LF with the visual-ranked assessment method and bitewing radiographs for occlusal caries detection. They found that VE and LF had similar results. According to their assessment

Ekstrand's visual scoring system¹⁵ was the most valid method for caries diagnosis. They commented that LF should be considered an adjunct to caries diagnosis because of its relatively high cost compared to VE. In suspicious cases, radiography and DIAGNOdent can be used as adjunct procedures.

CONCLUSION

It can be concluded that the laser fluorescence can be successfully used as an adjunct tool in the diagnosis of occlusal dental caries.

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