

## Evaluation of DIAGNOdent Values Before and After the Application of Opaque Fissure Sealant to Permanent Teeth

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### Abstract

**Background and Aim:** The ability of DIAGNOdent (DD) for detection of occlusal caries under sealant and its reproducibility is a matter of question for dentists. The aim of this study was to evaluate DD values before and after the application of opaque fissure sealant (FS) and to determine the reproducibility of DD for detection of occlusal caries under sealant.

**Materials and Methods:** This study was carried out on 42 extracted sound human premolar and third molar teeth. Two examiners assessed the deepest occlusal pit of teeth with DD Pen (Kavo, Germany). This evaluation was repeated one week later to assess DD reproducibility. Assessment with DD was also performed after acid etching and FS application. The results were recorded and analyzed using linear regression test and SPSS software.

**Results:** The intra-examiner reproducibility of DD was 75.49% and 77.56% for the first and second observers, respectively. The mean DD value after etching and FS therapy increased by 28 and 6 units, respectively.

**Conclusion:** DD has high reproducibility making it suitable for the monitoring of occlusal caries. However, DD value is influenced by the opaque sealant and thus, it should not be used as the sole device for detection of caries under sealants.

**Key Words:** Fissure sealant , occlusal caries , laser fluorescence , DIAGNOdent

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### Introduction

High prevalence of caries in occlusal pits and fissures is a challenge for epidemiologists and dentists [1, 2].

Studies have shown that about 80% of dental caries in children and adolescents occur in occlusal pits and fissures while occlusal surfaces comprise only about 12.5% of total tooth surface [3].

Fluoride therapy and FS therapy are among the conventional methods to prevent caries in fissures. Many clinical studies have confirmed the success of FS in reducing the prevalence of occlusal caries. Reduction in number of living bacteria in sealed

occlusal fissures has also been reported in several studies.

Conventional methods for detection of occlusal caries include visual observation, examination with an explorer and use of bitewing radiography. At present, due to inadequate precision, errors and problems associated with the mentioned diagnostic techniques, some questions have raised regarding their efficiency. Furthermore, none of the mentioned methods are able to precisely detect caries under FS. Bitewing radiographs are not capable of accurately detecting enamel caries and thus, are not suitable for detection of primary caries in fissures

[4, 5]. Specific morphology, development of hidden caries deep in fissures and application of FS to fissures suspected of caries all emphasize the importance of accurate diagnosis of occlusal fissure caries and use of new diagnostic techniques for this purpose.

Several new methods such as fiber-optic transillumination (FOTI) and laser fluorescence (LF) have been suggested to more precisely detect occlusal caries; among which, LF has become more popular for detection of occlusal caries. In the past 10 years, several studies have investigated the efficacy of DD for detection of caries under sealants. The majority of the mentioned studies have confirmed its efficacy for detection of caries under clear sealants and suggested further assessments in this respect [8, 9, 10, 11, 12]. Literature regarding the efficacy of DD for detection of caries under opaque FS is scarce [8, 9, 10, 12]. The present study aimed to determine the ability of DD for detection of caries under opaque sealants.

### Materials and Methods

A total of 42 extracted sound human premolar and third molar teeth without cavitated carious lesions were evaluated. Until reaching our sample size, the teeth were stored in saline solution.

In order to facilitate the use of DD and matching its position and experiment conditions, the teeth were mounted in dental stone and coded.

Any plaque or foreign body in occlusal fissure of teeth was removed by gentle movement of explorer tip followed by water and air spray for 20s. The tooth surface was then air-dried using air spray.

The deepest pit in the occlusal fissures was selected for assessment by DD (DIAGNOdent pen, Kavo, Germany) using the standard method recommended by the manufacturer. This assessment was done by two observers. In order to reproduce the same position of DD in the next steps, the stone was marked by an arrow indicating the selected pit and the position and direction of DD. The values obtained in the first phase were registered in a table.

To determine the reproducibility of DD, the procedure was repeated by the same two observers one week later and the obtained values were recorded. At each time of using DD, the teeth codes were changed by a third person blinded to the results;

thus, the two observers were blinded to the teeth codes.

To reduce errors, DD was calibrated by a ceramic stone as recommended by the manufacturer before each time of application. In the third phase, the selected pit was etched with 37% phosphoric acid present in the opaque FF pack (Ivoclar) for 20s followed by 20s of rinsing with water spray and 20s of drying with air spray. DD was used on the same pit and the displayed value was registered in the table.

After this step, all teeth received FS therapy without fissurotomy and cured for 40s. DD was used on the FS and the displayed value was recorded and registered in the table.

The obtained values in the 4 steps of the study were analyzed using linear regression and SPSS version 11.5 software.

### Results

The mean DD value was 13.37 before FS therapy, 41.54 after etching and 19.23 after FS therapy. Thus, the mean DD value increased by 6 units after FS therapy. According to the regression equation:

$$Y=0.082* X+6.32$$

where Y is the estimated DD value before FS and X is the actual obtained DD value after FS and 0.027 is the correlation coefficient, a significant difference existed between the DD values before and after FS therapy.

After etching, the mean DD value significantly increased (about 28 units) as well. Furthermore, the intra-examiner reproducibility of DD was 75.49% and 77.56% for the first and second examiners, respectively.

### Discussion

Studies have shown that the process of caries development under sealed composite restorations can be stopped. A reduction in number of microorganisms in these sites has been observed as well [13, 14, 15].

Adequate retention and optimal fit of sealants are determining factors for the cessation of extension of carious lesions. When the sealant is completely or partially lost, the process of caries development resumes [16]. Survival of sealant restorations depends on routine check ups [17]. Although sealant retention cannot be thoroughly monitored in the

clinical setting, DD has shown reliable results for detection of occlusal caries [18, 19, 20]. As mentioned earlier, the mean DD value after opaque FS therapy increased by 6 units; whereas, in the study by Hosoya the mean DD value decreased after the application of different types of sealants (clear, red and white). Similar reduction in DD values was also reported in a study by Deery after the application of clear sealant. Hosoya believes that detection of caries under sealants by DD is questionable [8, 11].

In Studies by Diniz and Askaroglou, the mean DD values increased after the application of clear sealant while these values decreased following the use of opaque sealant [10, 12].

Such conflicting results may be attributed to the followings:

In our study, the teeth were stored in saline solution that has no effect on fluorescence signals; whereas in previous studies, the teeth were kept in 1% timol solution or were frozen. It has been confirmed that when teeth are stored in timol, formalin or chloramine solutions, their DD values decrease. In contrast, freezing the teeth increases their DD value [21, 22].

The teeth selected for our study were all apparently intact; whereas previous studies have evaluated teeth with a wide range of caries from intact to cavitated dentin caries.

In contrast to previous studies, we marked the location, position and direction of DD by drawing an arrow on the stone before the application of sealant. The only exception is the Askaroglou's study. They scanned the entire fissure to eliminate this problem [10].

In addition to the above-mentioned factors, difference in sample size, duration of etching and curing, penetration of sealant and type and composition of used materials can all affect the obtained results.

In our study, the mean DD value significantly increased after etching from 13.37 to 41.54. In a study by Krause, the mean DD value increased from 15.8 to 54.1 [9]. It has been proved that hydroxyapatite crystals significantly contribute to scattering of light. Thus, the increased fluorescence values in their study may be due to the changed pattern of light propagation through the etched enamel [23]. This finding needs further microscopic investigation in future studies.

In our study, the reproducibility of DD was 75.49% for the first and 77.56% for the second examiner; which are both optimal and in accord with the results of previous studies.

In Krause's study, no significant difference was detected in terms of reproducibility of DD values between the two observers after one week; which indicates high reproducibility of this device [9].

In the study by Askaroglou, the inter-examiner reproducibility was found to be excellent for both deciduous and permanent teeth [10].

In Studies by Poorhashemi and Deniz, the reported reproducibility of DD was slightly higher than our obtained rate [12, 24].

Obviously, we had to eliminate differences in conduction of study as much as possible to achieve more accurate results. However, some small differences were inevitable and need to be minimized in future studies.

### Conclusion

Considering the optimal reproducibility values of 77.56% and 75.49% for our first and second examiners, respectively, DD is recommended for monitoring of occlusal caries. However, it is not suitable for detection of caries under opaque sealants.

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