ORIGINAL RESEARCH

Comparison of Visual Examination, Bite-wing Radiography, and Fiberoptic Transillumination on Caries Detection

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ABSTRACT

Introduction: The detection of carious lesions in the initial stages of development is very important to prevent the occurrence of cavitation. Visual examination and the use of a dental probe, bite-wing radiography, and fiberoptic transillumination (FOTI) have long been recommended for this purpose. Visual examination and probing of suspected lesions are useful for detecting occlusal caries, but achieve no gain of sensitivity and might cause irreversible tooth damage. Bite-wing radiography helps to detect approximal lesions better than clinical examination and probing the lesion. But the diagnostic performance of bite-wing radiography at approximal and occlusal sites is different. The FOTI is a quick and inexpensive method that can enhance visual examination of all tooth surfaces.

The aim of this *in vivo* study is to compare FOTI with bite-wing radiography and visual examination in the detection of approximal and occlusal caries.

Materials and methods: A total of 46 patients without missing teeth and dentures in the posterior region of jaws were examined for the evaluation of all premolar and molar teeth contacts. Three blinded practitioners examined the patients. First one evaluated radiologically, second one visually, and the last one evaluated with FOTI.

Results: According to statistical results, bite-wing radiograph had the highest sensitivity. However, evaluation with FOTI had acceptable results to detect approximal caries.

Conclusion: Study of the results has shown that clinically FOTI is an adjunct method for detection of approximal caries.

Keywords: Bite-wing radiography, Caries, Fiberoptic transillumination.

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INTRODUCTION

The detection of carious lesions in its initial stages of development is very important to prevent the occurrence of cavitation. Visual examination using a dental probe, bite-wing radiography, and FOTI has long been recommended to detect the initial carious lesions. Visual examination and probing of suspect lesions are useful for detecting occlusal caries, but achieve no gain of sensitivity and might cause irreversible tooth damage.[1] However, bite-wing radiography helps to detect early approximal lesions better than clinical examination and probing the lesion; some artifacts, such as cervical burnout may lead to misdiagnosis by imitating the proximal carious lesions.[2] For that reason, the diagnostic performance of bite-wing radiography differs in the detection of carious lesions depending on the site of the teeth. Even though early approximal caries that occur within the enamel layer can be detected clearly, bite-wing radiography is not helpful for early diagnosis of occlusal caries because of superimposition of enamel layer. Although bite-wing radiographs are very useful in the diagnosis of cavitated approximal caries, it entails use of ionizing radiation, which is not suitable for pregnant women and children.[3-6] In addition, practitioners have to be well educated to perform the radiologic method of bite-wing radiograph for preventing unnecessary radiation exposure. The FOTI is a quick and inexpensive method that can enhance visual examination of all tooth surfaces.[7] But success of this method depends on calibration and improvement made by the practitioner.

The aim of this *in vivo* study is to compare FOTI with bite-wing radiography and visual examination in the detection of approximal and occlusal caries.

MATERIALS AND METHODS

A total of 46 patients who were referred to Ankara University, Faculty of Dentistry Hospital and who had no lack of teeth and dentures in the posterior region were
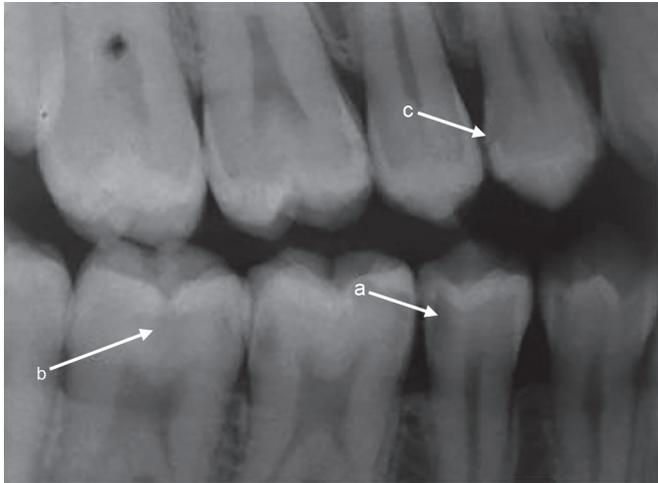
Fig. 1: Bite-wing radiograph shows different stages and sites of carious lesions: Arrow a showing approximal cavitated caries; Arrow b showing occlusal cavitated caries; and Arrow c showing approximal enamel caries

Fig. 2: The FOTI view of the left upper second premolar tooth with a distal cavitated carious lesion (black arrow)

selected to assess all of the premolar and molar teeth contacts clearly and examined for the study. Informed consent form was signed by patients, who had accepted to be a part of the study. Ethical clearance from the local Ethical Committee was also received for the study. Clinical and radiological examinations were the already used routine methodologies. Therefore, patients were not additionally irradiated except for routine radiological examination. Bite-wing radiographs, which were taken to examine proximal teeth surfaces, were also used to examine occlusal surfaces to uncover potential caries problems if possible. Three blinded practitioners, who were undergoing education in the dentomaxillofacial radiology department as research assistants, examined the patients. First one evaluated radiologically, second one visually, and the last one evaluated with FOTI. The reason why a different observer performed each examination method was to prevent them from being affected and prejudiced by another examination method. Observers were informed on how to determine the carious lesions by using quintet scale (0—no caries, 1—probably no caries, 2—no comments, 3—probably caries, 4—definitely caries). The FOTI examinations were made in a dark room and the responsible examiner was trained to be able to detect caries in the dark room before she began examining the patients. All the patients were examined by three observers separately in order of visual examination, radiological examination, and finally FOTI examination.

Data obtained from all three methods were grouped, according to the ones used for caries type detection (visual, radiological, and FOTI data for approximal caries detection; radiological and visual data for occlusal caries detection; radiological and FOTI data for approximal enamel caries detection) and analyzed with Statistical Package for the Social Sciences version 15.0 package program.
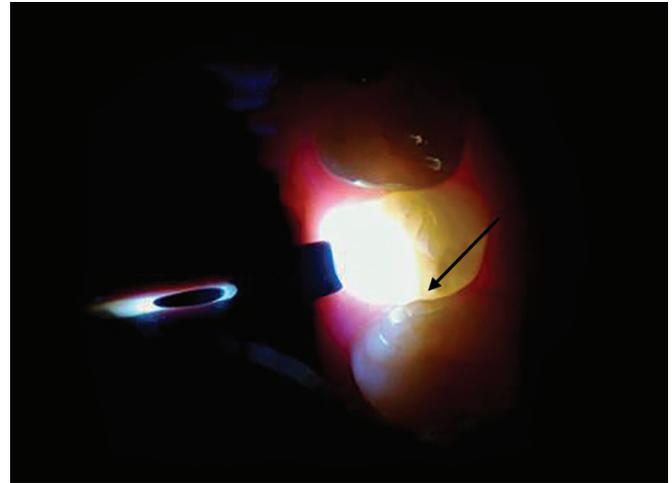
Nonparametric Mann–Whitney U-test was used to compare the differences between individual groups of two (radiological and visual examinations for detecting occlusal caries; radiological and FOTI examinations for detecting approximal enamel carious lesions), and Kruskal–Wallis test was used to find the significance of the difference between the three group (visual, radiological, FOTI examinations for detecting approximal caries) means. Data obtained from radiological examination were used for gold standard (Fig. 1) and compared with visual examination and FOTI in the detection of approximal caries (Figs 2 and 3). Also, data of visual examination were used for gold standard in the detection of occlusal caries and compared with radiological examination and FOTI (Figs 1 and 4). Thus, radiological, visual, and FOTI examinations were compared for detecting approximal caries; radiological and visual examinations were compared for occlusal caries detection; and finally, radiological and FOTI examinations were compared in the detection of approximal caries within enamel layer, which could be considered as initial lesion.
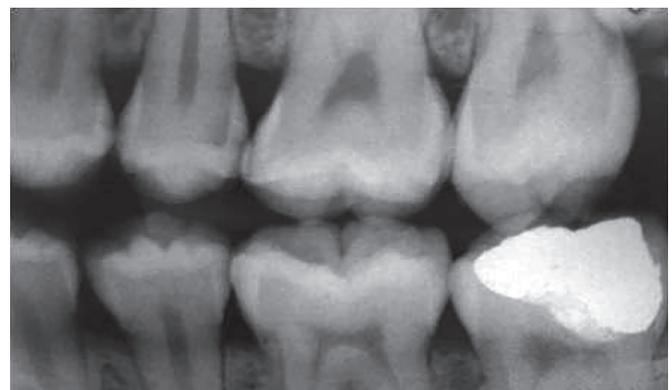

Fig. 3: Bite-wing radiograph of the same left upper second premolar tooth with a distal cavitated carious lesion

Fig. 4: Intraoral clinical appearance of occlusal carious lesion in the occlusal site of right upper second molar tooth

RESULTS

Totally 920 teeth were examined in 46 patients. Data obtained from radiological examination showed that carious lesions were found in 25.4% of all approximal surfaces. According to comparison of radiological examination as gold standard in the detection of approximal caries, the FOTI examination with 12.7% had a significantly higher rate than visual examination with 7.8% (Table 1). Occlusal carious lesions were found in 7.6% of all teeth by visual examination and probing of suspicious pit surfaces in the occlusal caries detection. Comparison of radiological and visual examinations in detecting occlusal caries showed that radiological examination was not eligible, especially in the detection of early occlusal caries. Radiological examination had a statistically significant lower percentage rate of 1.5% than visual examination, as gold standard, with the percentage rate of 7.6% (Table 2). Table 3 shows the

Table 1: Statistical success rate percentages of the three methods used for detection of approximal caries within dentin

FOTI examination	117 (12.7%*)	920 (100%)
Visual examination	72 (7.8%*)	920 (100%)
Radiographic examination	234 (25.4%*)	920 (100%)

*statistically significant (p ≤ 0.05)

Table 2: Statistical success rate percentages of the three methods used for occlusal caries detection

Visual examination	70 (7.6%*)	920 (100%)
FOTI examination	62 (6.7%)	920 (100%)
Radiographic examination	14 (1.5%*)	920 (100%)

*statistically significant (p ≤ 0.05)

Table 3: Statistical success rate percentages of the two methods used for detection of initial approximal caries within enamel

FOTI examination	102 (11.1%*)	920 (100%)
Radiographic examination	71 (7.7%*)	920 (100%)

*Statistically significant (p ≤ 0.05)

performance of radiological examination and FOTI in the detection of initial approximal lesions, which can be described as carious lesions remaining limited in the enamel layer. Initial approximal lesions were found in 11.1% of all approximal surfaces by radiological examination. Although, FOTI had a comparatively high success rate of 7.6%, statistically significant results were found between two examination methods in the detection of initial approximal lesions.

According to statistical results, bite-wing radiography had the highest efficiency in the detection of approximal caries. However, evaluation with FOTI had acceptable results to detect approximal caries. Visual examination is especially effective for early occlusal caries detection.

DISCUSSION

It is important to detect carious lesions in the early stages of development. Due to the dynamic nature of lesion progression, initial carious lesions, which have been limited within the enamel layer, can be blocked by the reestablishment of physiological balance between tooth mineral and the oral environment.[8,9] For that reason, the role of bite-wing radiographs on detection of early caries lesions has been accepted as a diagnostic aid especially for cavitated approximal caries for many years. Also, the results of the present study confirmed that radiological examination had the highest success rate (25.4%) when compared with visual examination (7.8%) and FOTI (12.7%). But, there have been some disadvantages for a group of patients (pregnant women and children), because of the thought of probable harmful effects of ionizing radiations. Besides, there are some problems associated with the bite-wing radiography technique, such as inaccurate horizontal angulation causing overlapping of approximal surfaces on the radiograph. Further, the method does not allow to distinguish noncavitated carious lesions from cavitated ones.[10] Results of the present study showed that bite-wing radiographs had the highest success rate of 25.4% to be able to detect cavitated carious lesions, which had reached into the dentin, whereas FOTI had a higher success rate of 11.1% than bite-wing radiographs of 7.7% in detection of initial enamel lesions.

In recent years, there has been a need of finding practical and alternative diagnostic methods for detection of approximal caries. The FOTI technique is one of these methods and has been used for many years for caries detection.[11,12] In this method, a white light is produced by a cold-light source and is passed through a fiber to an intraoral fiberoptic light probe. The probe is placed on the buccal or lingual side of the tooth and an observer examines the surfaces through transmitted light, which is viewed from the occlusal surface. A carious lesion has a lowered index of light transmission and so appears as

a darkened shadow when transilluminated.[13] The FOTI is a simple, noninvasive, and painless visual examination technique that can be used repeatedly with no risk due to the ionizing radiation to the patient.

Although clinical examination remains the basic detection system for dental caries, several studies have shown that it is not very accurate in detecting carious lesions in approximal surfaces.[9,14-18] Pitts[19] concluded that clinical examinations alone generally detected less than 50% of the "total" approximal lesions found with clinical plus radiographic examinations. According to the results of the present study, while clinical examination confirmed only about 30% of the carious lesions that were detected by bite-wing radiographs, FOTI was able to detect almost 50% of these lesions. Thus, results of the present study are compatible with the literature.

In this study, clinical visual examination detected the least number of cavitated approximal carious lesions. It is suggested that the temporary tooth separation increases the success rate of visual examination for carious detection. It was found in the literature that visual examination with tooth separation is more successful than FOTI for carious detection.[10,11,18,20] Temporary tooth separation with an elastic separator or some other apparatus is a method for the diagnosis of the integrity of approximal surfaces.[11,19,20] In clinical practice, the temporary tooth separation method is recommended when the diagnosis is uncertain.[19] But, in the present study, three different experienced and calibrated observers examined the patients without any uncertain diagnostic dilemma. So, there were no cases that needed to use temporary tooth separation.

Detection of occlusal caries depends on the depth of the carious lesion. Initial enamel lesions of the occlusal surface can be better detected by visual examination than radiological examination because of superimposition of enamel layer.[1,21] Success rates of visual examination and FOTI in detecting occlusal carious lesions were similar according to the results of the study. However, results of the radiological examination showed lower success rate in the detection of occlusal caries. This might be because most of the occlusal carious lesions examined in the present study were initial lesions. Thus, bite-wing radiographs stayed inadequate in the detection of initial occlusal lesions when compared with visual and FOTI examinations.

CONCLUSION

The detection and diagnosis of dental caries are difficult. Bite-wing radiographs are valuable in detecting cavitated approximal caries. But, this method unavoidably exposes the patient to the hazards of ionizing radiation. So, it becomes unavailable for some groups of patients like pregnant women and children. Also, FOTI is significantly effective to detect approximal caries. Results of the study showed that if there are some barriers to exposing certain patients to ionizing radiation, then clinically, FOTI is an adjunct method for detecting approximal caries in that group of patients, such as pregnant women and children. Clinical examination alone is insufficient for caries detection by comparison with FOTI and bite-wing radiographs.

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