

Accuracy of dental radiographs for caries detection

Abstracted from

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Question: How accurate are dental radiographs for caries detection?

Data sources Medline, Embase, Cochrane Central and grey literature, complemented by cross-referencing from bibliographies. Diagnostic reviews were searched using the Medion database.

Study selection Studies reporting on the accuracy (sensitivity/specificity) of radiographic detection of primary carious lesions under clinical (*in vivo*) or *in vitro* conditions were included. The outcome of interest was caries detection using radiographs. The study also assessed the effect of the histologic lesion stage and included articles to assess the differences between primary or permanent teeth, if there had been improvements recently due to technical advances or radiographic methods, or if there are variations within studies (between examiners or applied radiographic techniques).

Data extraction and synthesis Data extraction was done by one reviewer first, using a piloted electronic spreadsheet and repeated independently by a second reviewer. Consensus was achieved by discussion. Data extraction followed guidelines from the Cochrane Collaboration. Risk of bias was assessed using QUADAS-2. Pooled sensitivity, specificity and diagnostic odds ratios (DORs) were calculated using random effects meta-analysis. Analyses were performed separately for occlusal and proximal lesions. Dentine lesions and cavitated lesions were analysed separately.

Results 947 articles were identified with the searches and 442 were analysed full text. 117 studies (13,375 teeth, 19,108 surfaces) were included. All studies were published in English. 24 studies were *in vivo* and 93 studies were *in vitro*. Risk of bias was found to be low in 23 and high in 94 studies. The pooled sensitivity for detecting any kind of occlusal carious lesions was 0.35 (95% CI : 0.31/0.40) and 0.41 (0.39/0.44) in clinical and *in vitro* studies respectively while the pooled specificity was 0.78 (0.73/0.83) and 0.70 (0.76/0.84). For the detection of any kind of proximal lesion the sensitivity in the clinical studies was 0.24 (CI 0.21/0.26) and 0.43 (0.41/0.45) and the specificity was 0.97 (0.95/0.98) and 0.89 (0.88/0.90).

With regard to the dentine lesions the sensitivities were 0.36 (0.24-0.49) for proximal to 0.56 (0.53-0.59) for occlusal lesions and specificities ranged between 0.87 (0.85-0.89) and 0.95 (0.94-0.96). No reports were found for cavitated occlusal lesions. For proximal lesions sensitivities were above 0.60 and sensitivities above 0.90. Diagnostic Odds Ratios (DOR) were >1 (indicates a useful test) and were higher in proximal than in occlusal lesions. The DOR calculated for proximal lesions *in vitro* studies was 16.0 (11.5/22.4) and DOR 7.5 (3.4/16.5) for clinical studies). Heterogeneity calculated using I² test was moderate: > 50-67%.

Conclusions Caries detection determined by dental radiographs is highly accurate for proximal lesions and dentine caries lesions.

For initial carious lesions the test needs to be used with other more sensitive methods in populations that present with high caries risk.

Commentary

Clinical and visual evaluation are the first steps for diagnosis in dentistry and they help to assess the patient's risk and they precede the use of other tools for diagnosis of dental diseases.

We have other adjunctive tools besides visual examination that are needed to properly diagnose the most common dental diseases such as caries and periodontal disease. Dental radiographs for many years have been an important adjunctive tool for diagnosis.

The issue for many diagnostic tools is to accurately diagnose as much as possible positively in the early stages of the disease to halt the progression and the subsequent damage created by the disease. In dentistry the detection of early carious lesions, especially those lesions that cannot be detected solely with visual examination, will eventually prevent the need for a restoration. We have been using dental radiographs to assist and to evaluate the existence and the extent of a carious lesion and they are the most indicated for caries detection (the authors searched for articles that evaluated intraoral radiographs and included bite-wings and periapical radiographs).

A methodologically sound systematic review was performed by the authors following the guidelines expected. Even though they included *in vitro* studies, they appropriately separated the data and provided results from clinical and *in vitro* studies.

A previous publication from 2001¹ that is frequently referenced summarises the sensitivity and specificity of some of the most common diagnostic tests in dentistry and shows similar results for the sensitivity and specificity of dental radiographs.

This review reinforces information that we already know from previous studies about the accuracy of dental radiographs for proximal carious lesions. It raises an important question about finding more sensitive methods to diagnose early caries lesions in populations with a high risk of caries, considering that caries is still a prevalent disease despite all the efforts worldwide for its control and prevention.

From a practical point of view, we know that radiographs alone are not a perfect tool for the diagnosis of oral diseases. Visual examination, other tools, and a thorough clinical and medical risk assessment should be performed, especially in populations at higher risk.

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1. Bader JD, Shugars DA, Bonito AJ. Systematic reviews of selected dental caries diagnostic and management methods. *J Dent Educ* 2001; **65**: 960-968.

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