

Editorial

Are Standard Pc Monitors Useful for the Diagnosis of Oral Lesions in Digital Radiography?

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EDITORIAL

Many kinds of lesions occur in the oral and maxillomandibular area. Some kinds of lesions, such as tumors or fractures, are similar to those that occur in other parts of the body. There are, however, some kinds of lesions that occur only in the oral region. Tooth caries are a good example of such lesions and accurate radiographic diagnosis of tooth caries is an important task for the dentist. The importance of accurate diagnosis is increased both because of the frequency with which carries occur and the fact that the severity of the carious lesion in question determines the nature of the treatment required [1].

The quality of digital radiographic images is dependent on each part in the imaging chain being built of the highest-quality and accurate equipment and materials. One of the most important links in this chain is the monitor. In medical radiology, many studies have been performed on the diagnostic capabilities and performance of various monitors, in such diverse fields as mammography and chest radiography etc. [2-4]. Partially in response to these studies, the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) published the 'Digital Imaging and Communications in Medicine (DICOM) Part 14: Grayscale Standard Display Function' report [5]. According to this report, the greyscale response of the monitor should be adjusted or perceptually linearized to allow the maximum number of distinct grey levels identifiable to the human visual system. Many medical monitors meet this standard automatically or manually. However, digital technology in dental radiography still lags several years behind medical radiography. Recently, several studies have compared the effects of monitors and environmental conditions on the diagnosis of tooth caries. Table 1 shows the results of these studies. Hellén-Halme et al. [6] compared the diagnostic accuracy between one PC monitor and two medical monitors. They found no difference between the monitors. In contrast, Isidor et al. [7] and Ilguy et al. [8] found differences between monitors. Isidor et al. studied two PC monitors and three medical monitors. One of the PC monitors showed higher sensitivity than the other PC monitor, and it also showed higher sensitivity than one of the three medical monitors. Ilguy et al. compared PC monitors and medical monitors using a photostimulable phosphor system. They found that the accuracy of the medical monitor was significantly higher than that of the

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PC monitor. Pakkala et al. [9] compared one PC monitor and two medical monitors and concluded and there were no differences between the monitors. Shintaku et al. [10] compared a PC monitor and a tablet PC (iPad2). They found that there was no difference between the PC monitor and the tablet PC. But they did not compare a medical monitor and a tablet PC. Some researchers have also studied the effect of environmental lighting conditions on diagnostic accuracy in digital radiography. Kutcher et al. [11] showed that the diagnostic accuracy in dim conditions was better than in bright conditions. And also Hellén-Halme et al. [12] found that it was easier to detect dental caries in dim ambient light conditions than in bright ambient light conditions. When comparing enamel caries, there was no difference between the lighting conditions. Pakkala et al. [9] compared bright with dim lighting condition using PC monitors and medical monitors. In their report, the observers obtained higher sensitivities with lower illuminance settings than with higher illuminance settings. However, this was accompanied by a reduction in specificity, which meant that there was no significant difference in overall accuracy. Also Hellén-Halme et al. [13] found that there was no difference between dim conditions and bright conditions when the monitor was calibrated to DICOM part 14 standards. As mentioned above, the efficacy of monitors for the diagnosis of dental caries is still the subject of some controversy. This may be the very low sensitivity in radiographic caries diagnostic ability which is sometimes lower than that by the chance [1]. There have been few studies on lesions other than tooth caries (Table 2). These studies have found that there was no difference between PC monitors and medical monitors in terms of diagnostic accuracy. Recent PC monitors have high performance specifications such as brightness over 250cd/m² and contrast ratios of 1000:1. This may be the reason why researchers have found no differences in the diagnostic utility between monitors. One of the weak points of all the studies mentioned herein is that the number of observers was relatively few.

These results suggest that standard PC monitors are useful for diagnosing oral and maxillomandibular lesions. The price of standard PC monitors is lower than that of medical monitors and this is an important factor for hospitals and clinics to consider.

Table 1: Effect of displaying conditions on diagnosis of tooth caries.

Authors (year)	Monitor type and other experimental conditions	No OB	Results
Kutcher, MJ et al. (2006) [11]	PC monitor Room light (dim, bright, bright with hood)	6	Hooded bright was better than bright. No difference with others.
Hellén-Halme K et al. (2009) [6]	One PC monitor and two medical monitors	7	No difference between three monitors.
Isidor S et al. (2009) [7]	Two PC monitors and three medical monitors	7	Sensitivity: One of the PC monitors > two of the medical monitors Specificity: One of the PC monitors < two of the medical monitors Accuracy: One medical monitor > other two medical monitors
Ilguy M et al. (2009) [8]	One PC monitor and one medical monitor	3	Specificity and positive likelihood ratios: medical monitor > PC monitor
Hellén-Halme K et al. (2012) [12]	One PC monitor Room light (dim: < 50lux; bright: 1000lux)	7	Az of dentine caries: 50lux > 1000lux Az of enamel caries: No difference
Shintaku WH et al. (2012) [10]	PC monitor and iPad2	4	No differences
Pakkala T et al. (2012) [9]	One PC monitor and two medical monitors Room light (bright and dim)	3	No difference between monitors Sensitivity: bright < dim Specificity: bright > dim
Hellen-Halme K et al. (2013) [13]	One medical monitor Room light (dim: < 50lux; bright: 1000lux)	7	No difference between the room light

Az: Area under ROC curve; PC monitor: Standard PC Monitor; Medical Monitor: High Performance DICOM part 14 Compliant Monitor; No OB: Number Of Observer

Table 2: Effect of displaying conditions on diagnosis of oral lesions other than tooth caries.

Authors (year)	Target lesions	Monitor type and other conditions	No OB	Results
McIlgorm DJ et al. (2013) [14]	Periapical lesion, impacted tooth.	Three PC monitors and one medical monitor for reference Visual grading scale analysis	6	No difference between PC monitors after calibration
Tofangchiha M et al. (2013) [15]	Tooth root fracture	One PC monitor and one medical monitor	2	No difference between the two monitors in sensitivity, specificity, accuracy

PC monitor: Standard PC monitor; Medical monitor: High Performance DICOM Part 14 Compliant Monitor; No OB: Number Of Observer

However, we need more detailed, broad, and large-scale studies to draw fully reliable conclusions.

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