IMPACT OF COMPUTERS IN RADIOGRAPHY AN OVERVIEW

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Background: Digital radiography systems were defined and categorized into Computed Radiography and Direct Digital radiography followed by a brief description of the CR systems. Radiography makes an vital contribution to the processes of examination, diagnosis and treatment planning. In the last decade, research derived from the fields of medical radiology and physics have demonstrated that unsatisfactory performing displays degrade image quality, thereby expand the potential for diagnostic outcomes. This has resulted in the establishment of quality in computer displays used in diagnostic radiology.

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INTRODUCTION: Computed radiography systems use a photostimulable phosphors please attached in a cassette. CR image acquisition is a process of two step and in the first step image capture and in the second step image read out. In the Direct digital radiography systems use detectors that have a combined image capture and image read out capability. DR systems are also called as DDR systems.

Digital radiography systems were defined & categorized into Computed Radiography and Direct Digital radiography systems accompanied by a rapid description of the CR systems.¹

DIGITAL IMAGING CHAIN

The generation of a radiographic image, is consequent to a series of steps. Analogue radiography information is recorded on emulsion-coated film, which then undergoes chemical processing to reveal the latent

image. In these Techniques important to noted positioning, exposure parameters and image processing all influence the quality of the main result. Digital imaging is dependent on these factors with the deviation that information collection and processing is undertaken through electronic means.¹ The distinct separation of the process of image possession, processing and display in digital radiography pros and cons also occurs. In the analogue film, alteration of image quality is possible at the time of image acquisition and processing. Only few or not alteration in the image is possible after chemical processing has been completed. In digital radiography, influence and manipulate information at any time after image received.²

The main aims of radiography are to receive maximum quality. Conversion to digital radiography, consequence image quality should parallel that of plain film. Various factors develop the impact of the quality of digital radiographs, and to place these in context several authors have coined the term ‘digital imaging chain. Sorantin outlined that the stages involved in digital image obtaining the raw data, data processing,

image display and interpretation of the image by the observer. This sequence of affairs occurs within an environment also be considered part of this ‘chain’.²

TYPES OF DISPLAY DEVICES

The majority of displays used in radiology today are liquid crystal displays (LCDs) backlit with cold-cathode fluorescent lamps (CCFLs). Newer display options include light-emitting diode (LED)—backlit displays.

DISPLAY PERFORMANCE FACTORS IMPACTING ON THE QUALITY OF DIGITAL RADIOGRAPHS: Medical imaging professionals such as radiologists, information technology specialists, and medical physicists routinely use a picture archiving and communication system use to transfer, process, store, and display all the medical images. If the radiologist is the “eyes” and “brain” of the radiology department, the electronic information technologies are the “lifeblood” that allows the circulation of acquired medical images so that it can be develop on a display or interpreted by the radiologist.

DISPLAY HARDWARE

Liquid Crystal Display Technology:

Displays used in radiology today are liquid crystal displays backlit with cold-cathode fluorescent lamps. Newer display options include light-emitting diode –backlit displays. LED backlights and CCFL backlights are used in similar ways.

Physical Properties and Characteristics of Displays:

The main features of a display are screen size and spatial resolution. The aim should be to have a display with an inherent resolution that matches the matrix of the images to be displayed, and a screen size that is appropriate for the viewing distance. For

In some of the display pixels, image, zoom and pan functions are required to check or identified all images information.

Display Calibration: To increase the contrast resolution in an image, it is compulsory to recognise the nature of the observer. Now the observer is human and capacity in question are related to the human visual system (HVS). HVS contrast sensitivity use to the concept of minor perceivable difference, or just noticeable

difference (JND). JND represents a perceivable change in luminance or light output, for a available luminance. The regular contrast alteration for a JND with spatial frequency with the framework luminance which our eye received.

Display Performance Criteria According to the American Association of Physicists in Medicine Task Group 18

Geometric distortion: Geometric distortion means any changes in digital images by the display device. AMLCD devices followed the criterion because display architecture is composed of a fixed arrangement of pixels. Geometric deformation can be occurs in presented images if the incorrect display resolution is chosen. It is important to make sure that displays are adjusted maximum as per required parameters.

Display Reflection: Specular reflection take place when the display face behaves like a mirror, reflecting incident light directly back to the observer. Diffuse reflection, referred to as ‘haze’, and express the internal scattering of incident light that is reflected diffusely from the display surface.

When choosing displays priority should be given to devices demonstrating a matt finish. During the radiographs room lighting should be minimize the reflection of light from the display face.

Luminance Response: One of the critical aspects of display performance impacting on image quality concerns the luminance response characteristics of the device. Luminance response comprises various criteria and show how a display manage the emission of light critical for image generation. The quality relevant to this parameter have been developed through the integrate efforts of the American Association of Physicists in Medicine Task Group 18.

The American College of Radiology (ACR). The AAPM TG18 defines the luminance response of displays as comprising three fundamental criteria – maximum and minimum luminance (L'_{max} and L'_{min}), contrast or luminance ratio (L'_{max}/L'_{min}) and contrast response (κ_{δ}). Maximum and minimum luminance refers to the maximum and minimum amount of light emitted from the display. The difference between these

two values defines the contrast ratio, more commonly referred to as the ‘dynamic range’ of a display. This is often expressed as a ratio to 1 and defines the limits of light a display can emit, from the very darkest to the brightest.

Luminance Uniformity: This defines the uniformity of light emission across the face of a display device. Significant variation in the emission of light across the display adversely affects the luminance response characteristics of a display, which in turn will affect the contrast of displayed images. The major factors contributing to luminance uniformity in AMLCD displays include the quality of the pixel architecture, uniformity of the liquid crystal layer and degeneration of the fluorescent backlights consequent to ageing.

Display Resolution: Display resolution commonly refers to the number of pixels in the vertical and horizontal dimension of a display. However, resolution in the truest sense refers to the capacity of a device to present detail in an image as separate resolvable points. One important factor influencing resolution concerns the

consistency of a display to accurately present contrast and this is determined by the luminance response characteristics of the device. The second factor influencing display resolution is pixel size, more commonly referred to as pixels per inch or PP and pixel pitch, representing the physical spacing between the individual pixels. Pixels represent the smallest picture element of the display through which light is emitted. In AMLCD displays, the physical pixel substructure determines both pixel size and pixel pitch. Images presented on displays with smaller more closely spaced pixel elements appear sharper with superior resolution compared to displays with larger and more widely spaced elements. Physically larger display devices do not necessarily provide improved image quality. As screen size increases, so do the number of pixels; however the size of the individual pixel elements may also increase.⁴ Lower quality displays usually demonstrate larger and more widely spaced pixel elements because they are cheaper to manufacture, whereas displays with smaller picture elements are usually associated with high

quality photographic and medical display devices.

Display Noise: Many factors contribute to noise, some of which are directly related to the display itself. The uniformity of the liquid crystal layer and display pixel architecture are both important contributors of noise in AMLCD displays. Peripheral to the display, the quality of the electrical signals transmitted to the display can represent a major source of image noise. An important but often forgotten contributor is the type of cable used to connect the computer system to the display. Preference should be given to using digital visual interface dual link or DVI-D cables instead of video graphics array or VGA cables to reduce electronic noise as much as possible. All currently manufactured medical grade displays utilize DVI-D connections.

ADDITIONAL FACTORS IMPACTING ON DIGITAL IMAGE QUALITY

The display driver or graphics card

One critical factor independent of the display is the quality of the graphics card. Use of graphic cards is to changes in electronic signal in to a digital than after it

generates the image. Poor quality of cards is not able to support and provide adequate amounts of information, resulting in information loss and inferior quality images. To maintain the quality it should be compared high quality of graphic cards, medical grades for the AAPM TG18 and DICOM Part 14 GSDF standards for display contrast and resolution. In addition, appropriately matched graphics cards are always recommended and often included in the sale of medical grade displays, emphasizing the importance of these devices to display performance.

Display performance and digital image quality

Display performance on digital image quality has been examined in several papers. Of interest are studies comparing the performance of commercial grade displays with medical grade devices. Medical grade monitors are expensive and the replacement of medical grade devices with commercial displays could translate to considerable cost savings. The displays were therefore deemed inadequate for the purposes of diagnostic medical radiology.

Unfortunately, these are limited and may in part be explained by the fact that the AAPM TG18 recommendations are relatively new. The performance characteristics of each display were recorded but the devices were not adjusted if they were found to be performing suboptimally. When a correlation between the diagnostic performance of the radiologists and the performance of displays was made, a statistically significant reduction in observer performance was observed with those displays, either demonstrating smaller contrast ratio values or maximum luminance levels below the AAPM TG18 standards.

Research studies specific to the dental profession have also investigated display performance in the review of digital dental radiographs. Investigated observer variation in the ability to detect artificial enamel lesions using four different types of AMLCD displays.

CONCLUSIONS

A great deal of research in the field of digital radiology has been undertaken in the last decade, which highlights the growing role this technology will play in future healthcare. Various benefits in transitioning

from plain film to digital imaging may included low radiation dosage to the patient and the ability to associate or stock all images in the health records and the elimination of film and dark room processing procedures. Considering that the acquisition and interpretation of a digital radiograph is consequent to a series of steps, the quality of the final product is dependent on what occurs during each stage of this process.

The use of digital imaging in will continue to grow in the advancement of medical field.

For the development of clear guidelines, education and research specific to this radiology technology should be given priority.

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