X – RAY DEPARTMENT

Lecture 14 **د. سـناء القصـاب**

Digital radiography in dentistry

General idea: digital radiography (D.R) is unlike conventional dental radiography, in D.R. no films or processing chemicals is used, instead D.R. uses an electronic sensor and computerized imaging system.

Definitions

Charge coupled device (CCD): A solid state detector used in many devices (e.g. fax machine) in D.R. a CCD is an image receptor found in the intraoral sensor

D.R.: A filmless imaging system, a method of getting a radiographic image using a sensor, breaking it into electronic pieces and presenting and storing the image using a computer.

Digital substraction: it's a method of reversing the gray scale as an image is viewed, i.e. radiolucent images (normally black) appear white and radiopaque images (Normally white) appear black.

Pixel: A discrete (smallest) unit of information also termed (picture element).

Sensor: it's a small detector that is placed intraorally to capture a radiographic image.

Purpose and use

1. To generate image used in diagnosis and assessment of dental disease.
2. To obtain information about the teeth and supporting structures.

More about the uses

1. To detect lesions, disease, and condition of teeth and surrounding structures.
2. to confirm or classify suspected disease.
3. to provide information during dental procedures (e.g. root canal therapy and surgical placement of implants).
4. to evaluate growth and development.

Fundamentals

- D.R. refers to a method of capturing a radiographic image using a sensor, breaking it into electronic pieces and presenting and storing the image using a computer.
- In D.R. the patient is exposed to x – radiation similar to that used in conventional radiography.
- The resulting image is displayed an a computer screen rather than a film that must be processed in a darkroom.

Types of digital imaging

Two method of obtaining digital image

1. Direct digital imaging

in this method we have an x -ray machine, an intraoral sensor and computer monitor

A sensor is placed into the mouth of the patient and exposed to x –ray, the sensor captures the radiographic image and then transmits the image into a computer monitor. Within seconds of exposing the sensor to x –ray image appears on computer screen, software is then used to enhance and store the image.

2. Indirect digital imaging

In this method we have a CCD camera and computer.

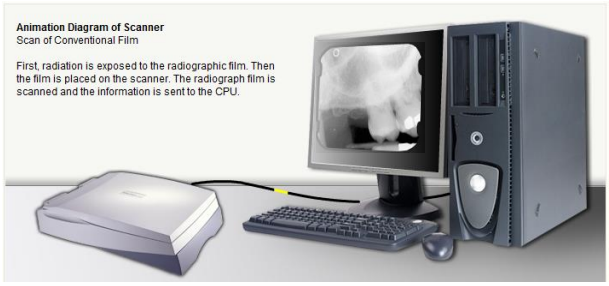
In this method, an existing x –ray film is (digitized) using a CCD camera. The CCD camera scans the image convert the image, and then displayed it on the computer monitor. The resultant image is similar to copy of the image versus the original image.

Equipments:

X – radiation source

Intraoral sensor

Computer.



1. **X – radiation source**

Always the conventional x – ray source can be used for digital imaging system however, the x – ray unit timer must be adapted to allow exposures in a time frame of 1/100 of a second. A standard x – ray unit that is adapted for digital radiographly can be functional for conventional radiography.

2. Intraoral sensor

The sensor is a small detector, placed in the mouth of the patient and used to capture the radiographic image.

Intraoral sensors may be wired or wireless. Wired refers that the sensor is linked by a fiber optic cable to a computer that records the generated signal. Wireless refers to sensor that is phosphor coated, is not linked by a capable.

Charge – coupled device: it is the most common image receptor used in dental digital radiography. The CCD is a solid state detector that contains a silicon chip with an electronic circuit embedded in it. This silicon chip is sensitive to x –ray or light. A pixel is a small box into which the electrons produced by the x –ray exposure are deposited. A pixel is the digital equivalent of a silver crystal used in conventional radiography. As opposed to a film emulsion that contains a random arrangement of silver crystals, a pixel is structured in an ordered arrangement. When x – rays activate electrons and produce such electronic charges, an electronic latent image is produced, the latent image is then transmitted and stored in a computer and can be converted to a visible image on screen or printed on paper.

3. Computers

A computer is used to store the incoming electronic signal. The computer is responsible for converting the electronic signal from the sensor into a shade of gray that is viewed on the computer monitor. Each pixel is represented numerically in the computer by location and level of color of gray. The range of numbers for a pixel varies from to 0 to 255 which creates 256 shades of gray (referred to as a pixel's gray scale resolution). the computer digitize, process and stores information received from the sensor. An image is recorded on a computer monitor in (0.5 to 120) seconds. The image may be stored permanently in the computer, printed on a hard copy for the patient record.

There are many viewing features such as split screen technology that allows the operator to view and compare multiple image on the same screen for comparison and evaluation of disease progression. Another viewing feature allows specific images to magnified up to 4 times their original size for evaluation of apical area of a tooth. Linear and angular measurements can be also be obtained a features that is helpful in measuring the length of the root.

Step by step procedure

1. sensor preparation: The placement of the intraoral sensor in the mouth of patient is similar to the technique used in conventional film placement, but the number and size of the sensor vary with different manufactures, each sensor is sealed and water proofed and for infection control, the sensor must be covered with a disposable barrier because it cannot be sterilized.

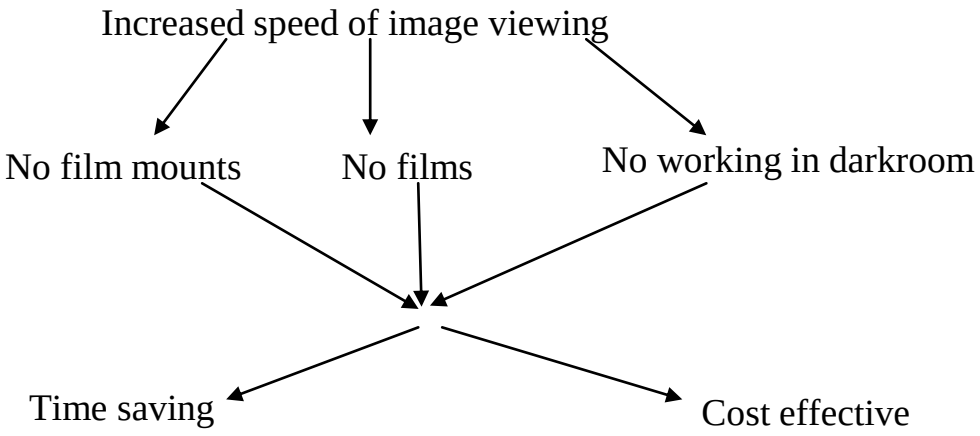
2.Sensor placement: The sensor is held by bite block attachment or devices. The paralleling technique is the preferred exposure method because of dimensional accuracy of images and the ease of standardizing such images. Paralleling technique film holders must be used to stabilize to sensor in the mouth. As with conventional intraoral film, the sensor is centered over the area of interest. As in conventional radiography, the x –ray is aimed to strike the sensor. An electronic charge is produced on the surface of the sensor, this electronic signal is converted into digital form. The digital sensor in turn transmits this information to a computer then the image is processed by a computer and stored by the software.

Advantage and disadvantages

Advantages

Superior gray – scale resolution: DR uses up to (256) colors of gray compared to the (16) or (25) shades of gray differentiated on a conventional film.

Reduced exposure to radiation: Decreased exposure results from the sensitivity of CCD so the radiation exposure is (50 to 80)% less than what is required for E – speed films.



Easy and fast communication: Digital images can be electronically transmitted to refereeing dentists or consultants

Enhancement of diagnostic images: Digital subtraction (D.S.) in which the gray scale is reversed as mentioned previously D.S. also eliminates distracting black ground information.

Disadvantages

Image quality: Conventional dental x –ray film has a resolution of (12 to 20) lP/mm while in CCD has a resolution closer to (10) lP/mm, (line pairs/mm) a CCD system appears to be adequate for diagnosis of dental disease.

Sensor size: The bulky nature of the sensor cause gag reflex for the patient.

Infection control: sensor cannot be sterilized by heat so it must be covered completely by a disposable plastic sleeve to prevent cross – contamination between patients

Initial set up costs: the range of cost depends on the manufacturer, the level of computer equipment and auxillary features e.g. an intraoral camera, service for any repairs must also be considered. The initial cost may reach to 10, 000$