## Radiology

Physics of Radiation 1<sup>st</sup> lecture 3<sup>rd</sup> level

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#### Introduction

- 1. Radiology is the science that deals with diagnosis, therapeutic and researches application of high energy radiation.
- Dental radiography is a process of image production for an object through the use of x radiation.
- 3. Radiologic examination is an integral component of the diagnostic procedure.
- 4. Dentists often make radiographic images of patients to obtain additional information beyond that available from a clinical examination or their patient's history.
- 5. Information from these images is combined with the clinical examination and history to make a diagnosis and formulate an appropriate treatment plan





Electromagnetic spectrum showing Photons used in dental radiography – *(blue)* have energies of 10 to 120 keV. Magnetic resonance *(MR)* imaging radio waves *(orange)*.

Physics of radiation (introduction, definitions and types of radiation). Roduction of radiation (xray machine, generation and interaction of x-ray with matter).

#### **Nature of Radiation**

Radiation is the transmission of energy through space and matter. It may occur in two forms:

(1) electromagnetic

(2) particulate

X – Ray was discovered by (Roentgen) in 1895, it travels in a form of pure energy and the basic unit is x - ray photon or (quantum).

• X – Ray photons travel with a wave motion called (sine – wave) and the distance between the crests of these waves called (wave – length) which measured by a unit ( $A^\circ$ ).

The X – ray photons wave length used in diagnostic radiography is ranged between  $0.1 - 0.5 \text{ A}^{\circ}$ .

The amount of energy contained in each photon called (photon energy) which depend on Wave length and Frequency of x - ray.

The high frequency of X – ray the shorter wave length photons this shorter wave length photon has more energy than a low frequency long wave length type of X – ray photons

## Comparison



#### between x – ray and light



- Both belong to the same electro magnetic radiation family.
- 2. Both travel in straight lines at the same speed which is 186,000 miles per seconds.
  - Both affected the photographic films and made them black.
    - Both not affected by magnetic fields
    - X-ray and light cast the shadows of the objects in the same manner
  - X-ray has the ability to penetrate objects that the light cannot pass through
  - X-ray has the ability to ionize atoms
- X-ray has the ability to produce light (blue light) when it hits some objective and this phenomena called (fluorescence).
- 9. X-ray is invisible

#### Components of X-ray machine and generation of X-ray

X- ray machines produce x-rays that pass through a patient's tissues and strike a digital receptor or film to make a radiographic image. The primary components of an x-ray machine are the x- ray tube and its power supply, positioned within the tube head.

A control panel allows the operator to adjust the duration of, and often the energy and exposure rate, of the xray beam.

Often an electrical insulating material, usually oil, surrounds the tube and transformers.

The tube is recessed within the tube head to increase the source-to-object distance and minimize distortion **X-ray tube** is composed of a cathode and an anode situated within an evacuated glass envelope or tube The glass of the tube is leaded to prevent (the generated X - ray) from escaping in all directions. While the window is of unleaded glass so that X – ray exist out through this window. The cathode consists of a filament and a focusing cup. The filament is the source of electrons within the x-ray tube. ((It is a coil of tungsten wire approximately 2 mm in diameter and 1 cm or less in length, and typically contains approximately 1% thorium, which greatly increases the release of electrons from the heated wire.))

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. The filament is heated by a low-voltage source and emits electrons at a rate proportional to the temperature of the filament. The filament lies in a focusing cup, a negatively charged concave molybdenum bowl. The electrons emitted by the filament into a narrow beam directed at a small rectangular area on the anode called the focal

#### spot.

The x-ray tube is evacuated to prevent collision of the fast-moving electrons with gas molecules, which would significantly reduce their speed.

The vacuum also prevents oxidation, of

## The anode in an x-ray tube

consists of a tungsten target embedded in a copper stem The purpose of the target in an x-ray tube is to convert the kinetic energy of the colliding electrons into x-ray photons. The conversion of the kinetic energy of the electrons into x-ray photons is an inefficient process, with more than 99% of the electron kinetic energy converted to heat.

#### characteristics of an ideal target material

- 1. High atomic number (74), allows for efficient x-ray production.
  - High melting point (3422°C), to withstand heat produced during x-ray production.
- High thermal conductivity (173 W m-1 K-1), to dissipate the heat produced away from the target.
- 4. Low vapor pressure at the working temperatures of an x-ray tube, to help maintain vacuum in the tube at high operating temperatures

To produce x-rays, electrons stream from the filament in the cathode to the target in the anode, where the energy from some of the electrons is converted into x-rays

## Types of radiation

- 1. Central ray: is X- ray photons that traveling in very center of the cone of radiation (radiation beam), and it's commonly used to fix and locate the position of X ray beam.
- **2. Bremsstrahlung radiation**: radiation produced when projectile electron is slowed by the electric field of target atom nucleus.
- **3.** Characteristic radiation: radiation produced when an outer shell electron fills an inner shell void (empty orbital).
  - **Primary radiation:** Radiation emerging from the X ray machine in form of collimated useful X ray beam
- **5. Secondary radiation**: Radiation result from interaction of primary beam with matter
- **6. Leakage radiation**: x-ray that escape through the protective housing and result in unnecessary exposure of the patient and radiologic technologist and have no value in diagnostic radiology.

Difinition of terms used in X - ray interaction:

- **Scattering:** change in direction of photon with or without a loss of energy.
- Absorption: deposition of energy i.e. removal of energy from the beam.
- Attenuation: reduction in the intensity of X ray beam caused by absorption and scattering attenuation = absorption + scattering.
   Ionization: removal of an electron from neutral atom

X-ray interaction with matter (Absorption of X – ray)

x – Ray absorbed by any form of matter (solid, liquid, and gas) when photons reach an atom,
different types of interaction may occur

depends on photon energy:



1. X – Ray photons can pass through the atom without any change occurred to both of them. Coherent scattering sometimes called classical scattering or Thompson scattering occur by interaction of low energy x-ray photon and atom. there is no loss of photon energy only changes in direction (photon of scattered radiation)

#### 3. Compton Effect:



occur between moderate energy x-ray photon and free or loosely bound outer shell electron of atom. It result in ionization of atom (ejection of Compton recoil electron), reduction of photon energy (there is some absorption of photon energy by ejected electron which undergoes further ionization interaction within the tissue), and change in xray direction (scattered radiation).



#### 4.Photoelectric effect:

occur by X – Ray photon interaction with inner – shell electron of the tissue atom (ex. From k shell) , the X – ray photon disappears and deposits all its energy this process is pure absorption.

The inner - shell electron is ejected with considerable energy (now called a photo - electron) in to the tissue for further interaction with other electrons of other tissue atoms So this high - energy ejected photo electron behaves like the original high energy X - ray photons interact and eject other electrons as it passes through the tissues, these ejected electrons are responsible for the majority of ionization interactions within the tissue and the possible resulting damage attributable to the X - rays.



When k electron removed out of its orbital, an electron from L shell falls in to k shell and release energy in the form of x-ray photon.
This photon has definite wavelength of a particular element, this phenomena is used to identify elements and the radiation is called characteristic radiation.

There are two other types of interaction **Pair production** (between high energy x-ray photon and nuclear force field) and photodisintegration (between high energy photon and nucleus) but both of them not occur in diagnostic radiology.

#### Filtration

X – ray used in dentistry must be able to penetrate dental hard tissues (teeth and bone). The longer wave length X – ray (soft X – ray) are not useful in diagnostic radiology thus removal of these long wave length photons from the beam by passing the beam through a filter made from Aluminum which absorb most of long wave length photons (soft X – ray), the resulting X – ray beam will consist mainly of X – ray photons with short wave length, high energy photons and high penetrating power that's why they named (hard X – ray beam)

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#### Types of filtration

1. Inherent filtration: done by filter built-in to the X – ray machine by manufacturer (as glass wall, the insulating oil and the metal housing of the tube). The inherent filtration tends to increase with age because some of tungsten metal of both target and filament is vaporized and deposited on the inside of the tube window.

2. Added filtration : done by using aluminum sheet as extra filter. \*[total filtration = inherent filtration + added

#### Collimation

Is a process used to control the size and shape of X – ray beam.

In diagnostic radiography its essential to get the diameter of circular X – ray beam at patients skin surface is not great than 2.75 inches, while for Rectangular X – ray beam the dimensions at the skin should be approximately  $1\frac{1}{2} \times 2$  inches.



#### Types of collimators:

Diaphragms (round or rectangular shape).
 Metal cylinders, cones and rectangular tubes.



#### Half - value layer



It's a method of monitoring the penetration quality of the X – ray beam.

# Determination of half – value layer is done by

Half – value layer

placing thin filtering material such as aluminum filter in front of the beam so we increase the thickness continue of filtering material until we have a thickness that reduce the number of X - rayphotons in the beam passing through it to (one half) this will representing a half value layer for such beam of radiation. High half value layer the high penetrating ability of the beam. In oral diagnosis the

#### X-ray measuring units 1.Traditional Units Roentgen ( R)

is the basic unit of radiation exposure for the amount of X-radiation or gamma radiation which will produced in one cc of air ions carrying one electrostatic unit of either sign.

\*Rad (roentgens absorbed dose) is a measure of the amount of energy absorbed by an organ or tissue. \*Rem (roentgens equivalent man) is a measure of the degree of damage caused to different organs or tissues. \*Becurie (Ci) : is the unit of quantity of radioactive material and not the radiation emitted by that material. \*RBE: is a relative biological effectiveness dose 2. International system of units SI

Units

- \*Coulomb per kilogram (C\kg) :
- ≈ 1 C\kg = 3876 R
  - \***Gray** (Gy) : 1 Gy = 100 rad
  - **\*Sievert** (Sv) : 1 Sv = 100 rem
  - \*Becquerel (Bq) :1 Bq=2.7 x

10\*11 Ci

## Thank you for your kind attention







## Radiograph:

Is the image of an object made with use of X- ray instead of light. Dental x- ray film:

Is a recording media on which image of the object was made by exposing this film to X- ray. **Types of X- ray film** a- Intra oral X- ray film.

b- Extra oral X- ray film.

Intra oral X- ray film Chemical composition of X- ray film

It consists of a sensitized emulsion مستحلب) (حساس present on both sides of transparent base(قاعدة حساسه) The base is the foundation of the , القاعدة هي اساس البنية الشعاعية radiographic film made from cellulose acetate. Its primary purpose is to provide a rigid structure onto which the emulsion can be coated. ترفير هيكل صلب عليها Its flexible and fracture resistant to allow easy handling but rigid enough to be 2 The emulsion is the heart of the x-ray film , it's the material with which the x-ray or light photons interact and forming the image وهي وهي وهي وتشكل الصورة وهي المادة التي تتفاعل معها الاشعة السينية وفوتونات الضوء وتشكل الصورة . It consists of homogenous mixture bromides خليط متجانس suspended (mainly silver bromides (بروميدات الفضة suspended) . The silver bromide crystals are sensitive to both light and any photons



by تغليف The intra oral film is wrapped opaque معتمة material to prevent light from reaching the film because light photons can activate the silver halides crystals. Also a thin sheet of (Lead foil رقائق الرصاص) is usually placed behind the film to prevent most of secondary radiation that originated in the tissue of the patient behind the film from لمنع الاشعاع الثانوي الذي نشا في reaching it. انسجة المريض خلف الفلم من الوصول اليها Therefore this lead foil

**1.reduces secondary radiation** 

2. minimizes film fog ضباب الفلم

3. the lead foil absorbs X- ray that have passed through the object and the film so it reduce the exposure of the tissue behind the film. This foil has a design of (herring bone pattern هذه الرقاقة لها تصميم). Intra oral film types Fig. 2: The contents of a film packet.

## Classified on numerical عددي basis into:

A - Type I Called periapical film used to examine the apical area of the tooth and the surrounding structures (record the crowns, roots, and surrounding bone). Film packs come in three sizes

Size 0 for small children (22 mm × 35 mm)
Size 1, which is relatively narrow and used for views of the anterior teeth (24 mm × 40 mm)

• Size 2, the standard film size used for adults (30.5 mm 40.5×mm)

So the available sizes are (1.0, 1.1 and 1.2 Presentation title



Fig. 2: The contents of a film packet.

#### **B\_**Type **II**

Is called bitewing film it used to detect the inter proximal caries and the height of alveolar bone between 2 adjacent teeth. Bite-wing films often have a paper tab projecting from the middle of the film on which the patient bites to support the film. Size 2 film is normally used in adults; the smaller size 1 is preferred in children. In small children, size 0 may be used. A relatively long size 3 is also available. So the size include (2.0, 2.1, 2.2 and 2.3)

#### C – Type III

Is called occlusal film that used to demonstrate area larger in dimension than area appearing in periapical film. the size is (3.4) only.



#### Intra oral film speed

Speed means the sensitivity of X- ray film silver bromide crystals (Ag Br) to X- ray photon. There is direct relation between the speed of the film and the size of the crystals, the **larger** crystal size the faster film speed. the faster mean it need less amount of radiation to produce radiographic image so less radiation dose absorbed by patient. The classification of film speed based on

alphabetical basis so from A to F, film speed A is the slowest while speed F is the faster one. Only films with a D or faster speed rating are appropriate ملائم for intraoral radiography.

E/F-speed film is preferred

because it requires

approximately half the exposure

time and thus half the radiation

dose of D speed film. In the United

States the most widely used films

are ULTRA-speed (D speed) and

## b- Extra oral film

The purpose of using such film is to make a radiographic image able to examine an area in and around the jaw that can't be seen by intra oral film,

Such as panoramic , cephalometric and other skull radiograph Types of extra oral film 1. Screen شاشة 2. Non screen

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## Non screen film

- 1. Film emulsion is more sensitive to X- ray than to light.
- 2. The film has double emulsion like intra oral film but the emulsion is thicker.
- 3. Increased thickness of emulsion make the non screen film need less amount of radiation so it need less exposure time.
- 4. The size of the film used

#### Screen film

- 1. Film emulsion is more sensitive to visible light and more specifically to blue light in the visible light spectrum.
- 2. The size include:  $5 \times 7$ ,  $8 \times 10$  and 10×12 inches The screen film placed between 2 وضع فلم .fluorescent screen in cassette الشاشة بين 2 كاسيت شاشة فلورسنت هذه الشاشة الفلورية مصنوعة These 2 fluorescent screen made from (tiny calcium tungestate crystals)., When these crystals exposed to X- Ray, the result of this exposure is a creation of light, this light in turn exposes the screen film to produce the image. عندما تتعرض هذه البلورات للاشعه السينيه فان نتيجه هذاالتعرض هي خلق ضوء وهذا الضوء بدوره يعرض فيلم الشاشه لانتلج الصورة



## Film properties

These include density, contrast and details or definition.

A. Density: Is the degree of blackness present in the processed film it measures in terms of light transmission on a percentage or logarithmic scale. Film density used in diagnostic radiograph is ranged from 0.25 to 2. Sensitometry is the study of the relationship between the intensity of exposure of the film and the وهي دراسة blackness after film processing العلاقة بين شدة تعرض الفلم للسواد والسواد بعد معالجة الفلم Film density measured by sensitometer or densitometer, and its relationship with radiation exposure is represented by H & D curve (Hurter and Driffield) يتم تمثيل علاقتها the more film. بالتعرض للاشعاع من خلال منحنى exposure to X- ray the blacker it becomes when processed

The optical density الخدافة الضوئيه OD of unexposed film are due to base density and fog density (background fog density المكثلوف الى كثافة القاعدة fog density (كثافة الضباب الخلفية).

الكثافة الاساسية هي The base density is the OD inherent الكثافة الاساسية in the film base and its due to the الكثافة الضوئية المتاصلة ع في قاعدة composition of the base and the tint added to it to make the الفلم ويرجع ذلك الى تكوين القاعدة والصبغة المضافة اليها لجعل الصورة الشعاعية اكثر radiograph more pleasing to eye ارضاء للعلية it's about 0.1), while fog density is related to بينما ترتبط كثافة الضباب بتطور الفضة the development of silver اللتى لاتحتوي على معلومات مفيدة فهى ناتجة عن تعرض الفلم اثناء grains that contain no useful information, it التخزين results from exposure of film during storage, undesirable chemical contamination, improper التلوث الكيميائي الغير مرغوب فيه والمعالجة الغير السليمهprocessing (should not exceed 0.2).

## Factors affect film density

1. Exposure time:

increase exposure time increases the film density.

2.Milliampere:

increase milliampere value (mA) which is usually ranged from 10 – 15mA, cause increasing film density.

3. Kiolvoltage:

increase Kilovoltage value (kV) cause increasing film density.

4. Developing time:

developing time usually range from 4 - 5 minutes. increase developing time cause increasing film density.

5. Distance:

increase the distance between x- ray tube and the film during exposure cause decrease film density on title

## B. Contrast: :

It means the graduation of differences in film density at different areas of a radiograph.

#### Type of contrast:

- Long scale مقياس or low contrast:- when many different film densities كثانة النام can be seen between totally clear and totally black areas of the radiograph. عند الاختلاقات وجود العديد من الاختلاقات
- 2. Short scale or high contrast:when few different film densities can be seen between totally clear and totally black areas of the radiograph..

The step wedge or penetrometer مقياس الاختراق او Is an object used to show the radiographic contrast it's usually made of aluminum and is constructed so that there is a constant increase in thickness of aluminum between the X- ray tube and the film. وهوجسم يستخدم المتباين ومصمم لاظهار التباين الشعاعي وعادة ما يكون مصنوع من الالمنيوم المتباين ومصمم والفلم بحيث يكون هناك زيادة ثابته في سماكة الالمنيوم بين انبوب الاشعه السبنيه والفلم

#### Factors affect contrast

**1.** Kilovoltage: increase kilovoltage

مقياس التباينcause increase the contrast scale

**2..Processing solution temperature:** معانجة

 معانجة solution temperature:

 معانجة درارة المحلول

cause decrease of contrast scale

C. Details or definition التفاصيل هي القدرة على Is the ability to reproduce sharp outlines of the object

#### Factors affect details

- 1. Focal spot size: size of focal spot must be as small as possible in order to produce sharp image.
- 2. Film grain size (film crystals): increase the size of film grain produce less sharp image.
- 3. Movement of patient head or X- ray tube or the film during exposure causes unsharp image.
- 4. Target object distance: which should be as great as possible, otherwise the image will be unsharp.
- 5. Object film distance: should be as small as possible to produce sharp image.
- 6. Screen film contacts: poor contact cause un sharp image

#### What will happen during exposure of X- ray film exposure to radiation?

- x- ray photons interact with
  - electrons of the atoms of the
- chemical emulsion in the Xray film
  - so the result is analog image,
- analog means the image appears identical to the original. لذا تكون النتيجة صورة تمثيلية تناظرية تعني ان الصورة تبدو مطابقة للصورة الاصلية

تشكيل الصورة الكامنة Latent image formation The Ag Br crystals in the film emulsion are changed whenever they absorb X- ray photons, the result of absorption 15 تترسب ذرة من الفضة في كل بلورة precipitation of silver in each exposed Ag Br بقعة of silver in each exposed Ag Br crystal to X-ray, collectively these specks are called Latent image which is invisible and in order to convert to visible image X-وهي غير مرئية ray film must be processed ولكى يتم تحويله الى صورة مرئية يجب معالجة فيلم الاشعه

#### Film\_processing

Its either manual or automatic processing .Processing cycle include:

Developing, rising, fixing, washing and drying. Developing:

Rinsing:

Fixing:

## **Developing:**

is the stage of processing during which the latent image is converted to a visible image.

X- ray film is placed in alkaline developer solution ,the action of developing agents are on exposed Ag Br crystals to continue the process of precipitating the specks of silver until all silver is deposit at the site of crystal and the bromine is released into the developing solution causing softening of the X- ray film emulsion

## **Rinsing:**

by water for 30s to terminates the developer action and remove chemicals from emulsion.

Fixing:

by using a fixer solution .its action is:

- 1. Re harden the film emulsion
- 2. Removed all the unexposed or undeveloped crystals.

After fixing the film washed in

running water & finally drying. <sup>14</sup>

## Dark Room

The darkroom or processing room is a place where the necessary handling and processing معالجة of radiographic films can be carried out safely and efficiently without hazard of producing film fog المنباب accidental exposure to light or x-ray. It may exclude all outside light and provides the artificial safelight only

#### Size and location of darkroom

Whenever possible oral radiography darkroom should be designed when the dental office is planned and should be convenient and easy to work with.

## The size of the darkroom depends on the followings:

1.Type & amount of the films to be processed, the greater workload need larger darkroom. Large films need large processing tanks, so it takes more space in the darkroom.

2.Extra space must be provided if more than one person works with ,9sq.ft. قدم مربع for one person is enough but it is advisable to have at least 20 sq. ft. of floor space for average dental office While for the location of darkroom, many requirements should be taken in consideration:

1. It can be conveniently reached from the rooms where the films exposed & examined.

2.Darkroom should be located where room temperature fluctuates as little as possible because the temperature of the processing solution must kept constant .It should be located in cool part of the clinic 3. Humidity الرطوبة تؤخر تجفيف الافلام drying of the processed films and damages unused films stored in opened films boxes.

4. The darkroom should be accessible to plumbing السباكة وخطوط الكهرباء& power lines.

5. The darkroom must also be well ventilated تهويه to provide a comfortable working environment

## Illumination of dark

- A ceiling light to provide ordinary illumination in the darkroom , its switch must be placed high enough on the wall to prevent the operator from accidentally turning it on during processing
  - Safe light , it consist of a filtered ضروء صافي light beam .this light is safe only when the correct watt-bulb is used and the fixture is placed at or beyond the recommended distance from the work area.
- 3. 3.Red warning light which is placed outside the entrance to the room , it should be wired wired whenever the safelight is turned on.

## Film storage

Film must be stored away from excessive heat and humidity.
 Chemicals must not be allowed to come in contact with stored films.

3.Objects should not be placed on top of stored films because pressure can cause film artifacts:تشوهات

4.The boxes of stored films should be lead lined المطنة بالرصاص or made of steel to prevent stray radiation from fogging تعفير the films.






# Thank you for your kind attention



#### .The main unit of x ray machine is

A- Collimator and pale screen B- X ray tube and power supply C-Cathode and anode D-Focal spot

#### B. The high frequency of X-ray

A- Long wave length, low energy B- Long wave length, high energy C-Short wave length, low energy D-Short wave length, high energy

All the following is characteristics of ideal target material except A- High thermal conductivity B- High atomic weight C-High melting point D-Low vapor pressure

D. Forty years old diabetic female with sever teeth mobility and tenderness in the right side of the lower arch you need to examine the alveolar bone present. Which one of the following films you use
A- Cephalometric radiograph
B- Occlusal film
C-Bitewing film

#### D-Periapical film

### E. The primary components of an x-ray machine are

A- X- ray tube, power supply B- cathode, anode C-Filter, collimator D-Tube head, Control panel

#### traditional units of rem is expressed in SI

## units

A- gray



**C-becquerel** 

**D-sievert** 

# Radiolog

Factors relating to the production of radiograph Lecture 3 3<sup>rd</sup> level

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Factors controlling x-ray beam , inverse square low
 Projection geometry (sharpness, distortion) and artifacts

Radiation Quantity: is the number of x-ray photons in the useful beam.

#### The factors affecting x-ray quantity are :

- mAs: x-ray quantity is directly proportional تتناسب طرديا to milliamperseconds.
- 2. kVp: x-ray quantity is directly proportional to the square of kilovolt Peak. مربع ذروة الكيلوفولت
- 3. Distance: x-ray quantity varies inversely تتناسب عكسيا with distance.
- 4. Filtration: يتم تقليل x-ray quantity is reduced by filtration, which absorb the low- energy photon of the beam عن طريق الترشيح الذي يمتص الطاقة المخفصة low- energy photon of the beam

## Radiation Quality جودة الأشعاع

is the penetrating power قوة اختراق of the x-ray beam, which is quantified التي يتم قياسها by HVL(Half Value Layer : Is the thickness of materials penetrated by one half of the radiation (mm, cm))

### The factors affecting x-ray quality are

kVp: x-ray penetrability قابلية اختراق الاشعة is increased as kVp is increased.

 Filtration: x-ray penetrability is increased when filters added to the beam. عنرافناف المرشحات.

#### **Inverse square law:**

قانون التربيع العكسي the low stated that ((the intensity of radiation inversely proportional with the square of distance measured from the source of radiation to the point of measuring the radiation intensity. ان شدة الأشعاع تتناسب عكسيا مع مربع المسافة المقاسة من مصدر الأشعاع الى نقطة قياس الأشعاع يتناسب عكسيا

الشدة I: intensity

D: Distance



مع تضاعف المسافه تتضاعف المنطقة اربع مرات

وبالتالي تنتشر كميه الاشعاع على تلك

المنطقة باكملها وبالتالي يتم تقليلها بشكل متناسب



بانتاج التصوير الشعاعيFactors relating to the production of radiograph

A/ Factors related to the radiation beam.

B/ Factors related to the object.

C/ Factors related to the X- ray film



## A / Factors related to the radiation beam.

- Exposure time: It's the interval during which X- rays are being produced. exposure time is directly related to the total photon production thus increase exposure time cause increase in the quantity of X- radiation that's why exposure time has direct effect on film density.
- 2. Milliamperage: Its related to amount of electricity pass through the filament circuit. So it's directly control the rates of X- ray photon production thus it has direct effect on film density.
- 3. Kilovoltage: kV it refers to the potential difference فرق الجهد between cathode and anode in the x- ray tube the higher kVp the greater is the potential difference and the greater is the energy of X- ray photons.



4. **Tube – film distance**: this distance consist of (tube – object distance) and (object – film distance)

\*The tube – film distance affect the intensity الشدة of radiation (according to inverse square law

\*The tube – film distance affect the exposure time directly.

\*The distance proportion inversely with the intensity of radiation.

\*The distance affect the dose of radiation because decrease the tube – film distance make the X- ray beam more diverge behind the skin area and more tissue is irradiated. While increase the distance makes the beam less diverges and reduces the amount of tissue irradiated.



5. Focal spot size: the focal spot or called the source of radiation must be as small as possible to get best image quality. So any movement in the head of X- ray machine affect the focal spot size.

6. Collimation: collimator الموازاة used to control the size and shape of the beam. Effect of collimation:

☐ Reduce the amount of tissue irradiated

☐ Minimize the production of secondary radiation fog.

\* Fog: is the unwanted film density (blackening) and thus reduce radiographic contrast. التباين





7. Filtration: the effect of filtration is the absorption of long wave length X- ray photons that have low penetrating power (can't penetrate the hard calcified tissue). The result of filtration of Xray beam is hardened beam (more short wave-length photon with high penetration power) so increase the half – value layer, also increase filtration affect the contrast and density but in different way, the contras التباين is decreased (long scale) like the effect of increase kV. While the density is decreased because when filtration increase the result is the absorption of not only long wave length photons but even some of short wave length photons so the number of X- ray photons or the quantity of radiation is reduced so the density is reduced.



8. Equipment efficiency كفاءة المعدات: dental X- ray machine differ in construction البناء and efficiency so the quality and quantity of X- ray beam vary from machine to another.





### **B** – Factors relating to the object:

The object is basically an absorbing X- ray medium, so 2 points important about the object during exposure to X- ray:

- Thickness of the object: Thick object required more radiation to make a radiographic image so it's often advisable المستحسن to increase kV or mA and /or exposure time in order to increase the amount of X- ray photons.
- 2. Density of the object: density refers to weight per unit volume of the object . In dental radiography enamel of the tooth has highest density of all body tissues. increase the density of the object increase its ability to absorb X- radiation . So hard tissue like enamel absorb great amount of radiation when compared with absorption of soft tissue like pulp because of object density.





- C Factors relating to the X- ray film:
- Reduction of secondary radiation: Secondary radiation include scattered, stray leakage or any other radiation that not belong to primary X- ray .Secondary radiation is un desirable because it reaches all parts of the film and produces film fog Several ways to minimizing this radiation like:- \*\*\*Using as small beam of radiation as possible. \*Proper collimation\_upil. \*In intra oral film a sheet of lead foil is placed behind the film in the film packet. \*\* In extra oral film a grid approximation is placed between the object and the film.



The grid is an extremely effective device for reducing the amount of scattered radiation that exiting an object and reaching the film. تعتبر الشبكة مادة فعالة للتقليل من كعية الاشعاع المتناثر الذي من الجسم ويصل الى الفلم Its composed of alternating strips aradiopaque material (usually lead) and strips of radiolucent material (often plastic). so the grid transmit only those x-rays whose direction is on straight line from the source to the film (image receptor) and **absorb** the remnant scattered radiation







2. Film and film storage: X- ray film must stored in light – tight – tight containers because the Ag Br Crystals in the emulsion are sensitive to light as well as to X- ray. Also film must stored in lead - lined box to keep the films away from the stray radiation, also stored in place away from excessive temperature or humidity and we should used it before the expiration

**3. Intensifying screen** شاشة مكثفت: Is a device جهاز يقوم بتحويل that convert the energy of x-ray beam into visible light, which interact with x ray film and forming the latent image. الصورة الكامنة Intensifying screen used in extra oral film to reduce patient dose by converting the x-ray to light so one x-ray photon give rise to many light photons, the number of x-rays required to produce the same density on the film is markedly reduced





4. Film processing القلم: The latent image is formed when silver halide grains are exposed to x-ray, then only the exposed grain الحبوب المكثونة will form the visible image by development. while the unexposed grains removed from emulsion by fixing and make a permanent image. (As mentioned in previous lecture), its either automatic or manual steps,

the automatic processing is preferred because it faster and resulted in better image quality





### Ideal radiographic projection

The term image quality describes the subjective judgment جودة الصورة هي الحكم الذاتي للطبيب The term image quality describes the subjective judgment الشعاعية by the clinician of the overall appearance of a radiograph. It depends on density, contrast التباين, latitude, وخط العرض والحدة والدقة, sharpness, resolution and other factors.

#### Ideal radiograph demonstrates certain image qualities include:

- A Radiographic image that is sharp.
- B Radiographic image that is shaped like the object.
- C Radiographic image that is the same size as the object.





**Sharpness** : is the ability of radiograph to define an edge precisely (like Dentinoenamel junction)

**Image Size Distortion** التكبير (magnification) is the increase in size of the image on the radiograph compared with the actual size of the object.

**Penumbra**منطقة الظلة العلى: Is the amount of un sharpness of the image so penumbra is the area of **partial shadow**.

**Umbra**منطقة الظل الكلي. Is the area of total shadow and it exist only when the object absorb all of X – rays. Penumbra is created by the size of focal spot (source of radiation), the larger the spot size the greater is the penumbra (the amount of un sharpness). penumbra not only affected by focal spot size but also affected by tube – object distance and object – film distance so the closer tube – object distance the greater is the penumbra while the closer object – film distance the lesser is the size of penumbra.







# Basic Principles of Projection Geometry for Radiography المبادى الاساسية لاساسية لاسقاط للتصوير الشعاعى

- 1. Source of radiation should as small as possible.
- 2. Tube object distance مسافة الجسم should be as great as possible.
- 3. Object film distance should be as small as possible.
- 4. Film should be parallel to an easily identifiable plane of the object.
- 5. Central ray of the beam should be perpendicular to the film The first
   3principles deal with the image sharpness while the last 2 principles required during exposure as a technique.

#### Radiographic errors and Artifacts: Classified into three categories: A.Technique and projection errors B. Exposure errors C. Processing errors

- 1. **Cone cut:** is clear unexposed area result from positioning fault when the X- ray beam not completely cover the film during exposure.
- 2. Back side exposure: when the film placed in wrong position making the non exposure side facing the beam, the result is the image with the pattern of the lead foil is evident.





- **3. Double exposure: when same film used** and exposed twice to X- ray this result in excessive dense and blurred image .
- 4. Elongated image: vertical angulation of X- ray tube was too shallow.

5. Shortened image: vertical angulation was too steep.

6. Over lapping of adjacent structures: when horizontal angulation was incorrect.



#### Horizontal and vertical angulations

Horizontal angulation: refers to X-ray beams direction in a horizontal plane.
 Vertical angulation: refers to X-ray beam direction in a vertical plane.

Plus vertical angulation: when the beam is tipped مائلا down ward Minus vertical angulation: when the beam is tipped upward





7. Blurred film: due to excessive bending of the film during placement for exposure.
8. Pale X- ray film: this due to either under exposure, or under developing.
9. Dark X- ray film: this is due to either over exposure or over development





**10. Completely clear film**: when put the film in fixer before developer. or when the film didn't receive radiation

**11. Undeveloped area**: this appear as clear area caused by incomplete immersion in developer (sometimes called developer cut-off) or sticking the film in the developer to the side of the tank.





12. **Scratched film:** when the film is processed in manual processor, the soft emulsion is easily scratched due to rough handling of the film , ex. scratched by holder, tank or nails.

13. **Developer spot**: black dots or dark spots on the film caused by drops of developer solution that was accidently spilled on the film before it was developed.







# Thank you for your kind attention



## Radiology

Biological effects of radiation

Lecture 4 3<sup>rd</sup> level

By: Dr. Yusra H. Al mukhtar

Department of oral and maxillofacial surgery

### Topics of lecture:

# 1. Biological effects of radiation (direct and indirect effects, deterministic and stochastic effect)

2. Safety and protection (for patients and operators)



Types of radiation 1. Non-Ionizing Radiation: Radiation that does **not** have sufficient energy to dislodge orbital electrons. ex.: microwaves, ultraviolet light, lasers, radio waves, infrared light, and radar.

2. Ionizing Radiation: Radiation that has sufficient energy to dislodge orbital electrons. ex.: alpha particles, beta particles, neutrons, gamma rays, and x rays.

All the atoms in human body has electrical stability when x- ray photon strikes ضربات a – ve electron in the atom of living subjects (tissues) it displace the electron leaving the atom electrically unbalance so the atom ionized such process called (ionization), this ionized atom has a strong tendency to seek تميل الذرة بشدة الى البحث عن استقرارها من خلال قبول its stability by الكترون واحد في مكان اخر accepting a -ve electron from somewhere else and by doing so a new chemical form and بذلك تغير شكل الى مادة كيميائية جديدةis the cell of which the atoms and molecules are parts can be altered. So that the basic effects ionization of are

Radiation biology is the study of the effects of ionizing radiation on living systems.

The initial interaction between ionizing radiation and matter occurs at the level of the electron within the first 10-13 second after exposure.

These changes result in modification of biologic الجزيئات البيولوجية molecules within seconds to hours. In turn, the molecular changes التغيير الجزئي to alterations in cells and organisms that persist for hours, decades, and possibly even generations. They may result in injury or death of the cell or organism. **Effects of ionizing** 

radiation

# **Radiation acts on**

living systems through

# direct and indirect

effects

# **Direct effect**

When the energy of a photon or secondary electron ionizes biologic macromolecules عندما تؤين طاقة الفوتون او الالكترون الثانوي الجزيئات البيولوجية الكبيرة the effect is termed **direct**. Those effects occurred in specific area of the body where all exposed cells in this area are altered directly by ionization process and death occurred at the time of **mitotic cell division**.

# **Indirect effect:**

It happened in several ways where new chemicals result from المواد الكيميائية الجديدة process of ionization are in الناتجة عن عملية التاين متوافقة مع انسجة الجسم compatible with body tissues ex: when photon absorbed عندما يمتص by الفوتون بواسطة الماء في كانن حي يؤين جزيئات الماء water in an organism, ionizing the water molecules.

### ex: when photon absorbed عندما يمتص الفوتون by water in an بواسطة الماء في كائن حي يؤين جزيئات الماء organism, ionizing the water

molecules. The resulting ions form free radicals (radiolysis of water) لانحلال الشعاعي للماء) (انحلال الشعاعي للماء) that in turn interact with and produce changes in the biologic molecules.

Because 'intermediate changes involving water molecules are required, so conversion of water to ' H2O2 which cause cellular dysfunction بسبب خللا خلويا



x radiation can alter the chemical composition of hormones enzymes and other body secretions make them partially or totally in effective such indirect effects depend on the amount of exposure to Xray.

This series of symptoms

### What are the stochastic العشوائية and deterministic العشوائية effects of radiation?

### **Comparison of Stochastic and Deterministic Effects of Radiation**

	Stochastic Effects	Deterministic Effects
Caused by	Sublethal DNA damage	Cell killing
Threshold dose	No	Yes
	There is no minimum threshold dose. Effect can be caused by any dose of radiation	Effect occurs only when the threshold dose is exceeded
Severity of clinical effects and dose	Severity of clinical effects is independent of dose; all-or-none response — an individual either manifests effect or does not	Severity of clinical effects is proportional to dose; the higher the dose, the more severe the effect
Relationship between dose and effect	Frequency of effect proportional to dose; the higher the dose, the higher the risk of manifesting the effect	Probability of effect independent of dose; most individuals manifest effect when threshold dose is exceeded
Caused by loses used in liagnostic adiology	Yes	No
Examples	Radiation-induced cancer	Osteoradionecrosis
	Heritable effects	Radiation-induced cataract formation
	Radiation-induced skin cancer	Radiation-induced skin burns
## Radio sensitivity of tissues and organs

Body tissues differ in their susceptibility to ionizing radiation. Cells are most sensitive to radiation when they are immature, undifferentiated, and rapidly dividing. As cells mature and become specialized they are less sensitive to radiation.

# The following tissue and organs are listed in order to their susceptibility to x-ray:

**1.high radio sensitivity:** lymphoid organs, Blood forming tissues (bone marrow), intestines, stem الخلايا الجذعية cells. lymphocyte and reproductive cells 2...intermediate radio sensitivity: Young or growing bone, Growing cartilage, glandular tissue, salivary glands, kidney, liver, lungs and epithelium of alimentary غذائي canal.

3. low radio sensitivity: Skin ,

muscle and optic lens.

4. the least effect seen in nerve tissue and adult

bone.

#### Short term

effects of radiation on tissue

seen in the first days or weeks

after exposure while long term

effects seen months and years

after exposure.

ALARA principle

(The law of radiation protection) قانون الحماية من الاشعاع

As Low As Reasonably Achievable: معقول ىشكل اقل Radiographs should only be taken at the minimum dosage with reasonable information, so the benefit from radiograph should be weighed against the radiation dose and then decide to take radiograph or not.

## Latent period

Is a period of time interposed between exposure and clinical symptoms such period varies with the dose.

So the more is sever dose the

shorter is the latent period.

sometimes the latent period is as long as 25 years for some minimum doses



## **Protection of patients from x-ray:**

The dentist is responsible for all aspects of safe radiation exposure in the dental office.

## This done by several ways:

- 1. Using faster (film speed) because the faster the film the less is the amount of radiation required to produce a radiographic image so it need less exposure time.
- 2. Collimation: this done by collimating device to prevent the un necessary beam divergence, especially rectangular collimator.
- **3.** Filtration:- in order to absorb the long wave length X-ray photons (soft radiation) which have no diagnostic value.



4. Exposure and developing techniques: - in order to prevent exposure of patient to much more radiation, we should know the exposure time for each segment of the jaw. So for anterior teeth the exposure time is 0.36 seconds for premolars is 0.40 seconds while for molars is 0.50 seconds if higher Kv. technique is used, its possible to use a constant exposure time for whole dentition. \* exposure time required for child and old people may have be decreased as much as 50% while exposure time required for dense and thick objects may have to be doubled. Some time when we use excessive long exposure time we have to decrease the developing time to get acceptable quality of radiographic image



5. Distance and kV:- the purpose of using cylinders and cones in the X-ray machine is to [limit the path لرية for X-ray] so X-ray beam hit only the examined area we have 2 cone length (8and 16 inches) the long cone mean increase tube film distance and when use higher kV With this cone we reduce the radiation dose absorbed by skin surface



- 6. **Film placement and angulations**:- this is important to prevent retakes and get a radiograph with best diagnostic information.
- 7. Lined cylinder: sometime lining the open cylinder by sheet of lead foil with 0.2 0.3 mm thickness result in elimination of scattered radiation.

8. Protective apron and thyroid collar: - sheet of lead used to cover chest and reproductive areas of the patient so must be used in pregnant and young adult also thyroid collar used for protection of thyroid gland. (lead apron used by operator also for protection).



- 9. Using intensifying screen شاشة مكفة in extraoral film to reduce radiation dose to patients.
- 10. Using digital radiography that provide Dose reduction of up to 90 per cent compared to E-speed film .



# Protection of operator and dose limits:

Operator received secondary radiation and generally workers in X-ray clinic should not receive more than **5 rem** of whole body radiation each year. Operator received 3 types of radiation (source of exposure):

- 1. Scattered radiation from the patient.
- 2. Primary beam if he stands in its path.
- 3. Leakage radiation from the tube head.



Fig 3: \* position and distance rule: if no barrier is available, the operator should stand at least 6 feet from the patient, at an angle of 90 to 135 degrees to the central ray of the x-ray beam when the exposure is made.



# To minimize the exposure of operator

1. **Position:** operator must stand **behind** the patient because the head of the patient will absorb scattered radiation operator must stand with an angle of 90 - $135^{\circ}$  to the radiation beam because in this area we have less scattered radiation

2. Barrier : it interpose between the source of radiation and the operator it is the most effective method of providing safety to the operator and barrier is made of lead or steel or concert or barium plaster of 1/16 inch. 3. Distance: the intensity of radiation **inversely** proportional to the distance (inverse square law) so it's recommended for him to stand 6 feet away from the 17

## شارات الفلمFilm badges

Is a blue plastic frame containing a variety of metal filters  $\alpha_{\text{tradia}}$  and a small radiographic film which exposed to X-ray. it provide a permanent record of the dose received by operators (radiographers and dentists) and it used for 1 – 3 months before being processed for monitoring of dose received by operator.



## Typical Effective Dose From Radiographic Examinations

Examination	Median Effective Dose	Equivalent Background Exposure
Intraoral		
Rectangular collimation		
Posterior bite-wings: PSP or F-speed film	5 µSv	0.6 day
Full-mouth: PSP or F-speed film	40 µSv	5 days
Full-mouth: CCD sensor (estimated)	20 µSv	2.5 days
Round collimation		
Full-mouth: D-speed film	400 µSv	48 days
Full mouth: PSP or E-speed film	200 µSv	24 days
Full-mouth: CCD sensor (estimated)	100 µSv	12 days
Extraoral	The second s	
Panoramic	20 µSv	2.5 days
Cenhalometric	5 µSv	0.6 day
Chest	100 µSv	12 days
Cone beam CD		
Small field of view (<6 cm)	50 µSv	6 days
Medium field of view (dentoalveolar, full arch)	100 µSv	12 days
Large field of view (craniofacial)	120 µSv	15 days
Multidetector CT		
Maxillofacial	650 µSv	2 months
Heads	2 mSv	8 months
Chest	7 mSv	2 years
Abdomen and pelvis, with and without contrast	20 mSv	7 years

Ref. of lecture: White and Pharaoh's. Oral radiology principles and interpretation. 8<sup>th</sup> edition 2019.



## Thank you for your kind attention







This lecture discuss the intraoral projections (periapical, bitewing and occlusal radiography

## **Periapical radiography Indication**

- 1. Detection of apical infection.
- 2. Assessment of periodontal status after trauma to the teeth and alveolar bone
- 3. Assessment of presence and position of un-erupted teeth.
- 4. Assessment of root morphology.
- 5. During endodontic.
- 6. Bone evaluation in pre surgical implant insertion



There are two commonly used intra oral techniques **a**/ **Bisecting technique**: Is the older and the easier of the two techniques.

**b**/ **Parallel technique** : It was originally developed by MC Cormack.

The result of this technique is superior to those of bisecting one.





#### Theory of parallel technique

It called so because film and the tooth must be parallel to each other. **The requirements of this technique are:-**

- 1. It requires the target object distance as long as possible and practical.
- 2. It requires the X-ray strike the object (tooth) and the film at right angle (90°).
- 3. It requires the film to be placed in a position parallel with the plane passing through the long axis of all teeth being examined.



The last requirement necessitates fairly wide separation of the tooth and the film, which produce considerable distortion intimedot in integration in the short target — object distance were employed. However, the use of extended long cone of 16 inches will increase the target — object distance and compensates for the distortion and un sharpness that result from increasing object — film distance.



## Theory of bisecting technique

- 1. Operator envisions an imaginary bisector of the angle formed by the long axis of the tooth and the long axis of the film, this angle is formed where the film contacts the tooth crown.
- 2. Operator direct the central ray of the beam through the apex of the tooth so central ray strikes the bisector at 90°, such angulations if properly employed results in a tooth image that is exactly the length of the object. In this technique, as a result of lack of parallelism between the tooth and the film since the film is in contact with the tooth crown, we have all the areas below the apex of the tooth as well as above are distorted and the degree of distortion can reduced by the use of long cylinder because the longer distance between the source of radiation and the object the more is the parallel will be the ray

#### Comparison between parallel and bisecting techniques



## نقطة التعريف:Identification dot

It's a round raising dot present in the corner of each film, allows rapid and proper film orientation and placement. The manufacturer orients the film in the packet so that the convex side of the dot is toward the front of the packet and faces the source of radiation. During film exposure, the film oriented to place the dot 2-3 mm away from the incisal or occlussal surface.

## Horizontal and vertical angulations

 Horizontal angulation: refers to X-ray beams direction in a horizontal plane.
 Vertical angulation: refers to X-ray beam direction in a vertical plane.

Plus vertical angulation: when the beam is tipped down ward Minus vertical angulation: when the beam is tipped upward

# Film placement and angulations for periapical films:



The anatomical area and the apex of the tooth under investigation should be shown, as well as 2-3mm of surrounding bone to enable an assessment of apical anatomy. Presentation title

## Angulations guidelines for bisecting angle projections

projection	Maxilla	mandible
Incisors	+40 degree	- 15 degree
Canines	+ 45 degree	- 20 degree
Premolars	+ 30 degree	- 10 degree
Molars O	+ 20 degree	- 5 degree

\* when occlusal plane is oriented parallel with the floor

#### The point of entry of central ray for each tooth

Area	Point of entry	
central incisors	Direct the central ray high on the lip, in the <b>midline</b> , just below the septum of the nostril	
lateral incisors	Orient the central ray to enter high on the lip about <u>1 cm</u> from the midline	
canine	The point is at about the intersection of the distal and inferior borders of the <u>ala</u> of the nose.	
premolars	This point is usually below the pupil of the eye	
molars	should be on the cheek below the outer canthus of the eve	





## bitewing films:

Bitewing X-ray film used to show the inter proximal caries and visualize the periodontal condition, in adult we need 2 bitewing film on each sides of the jaw at premolar and molar area while in children of 12 years old we need one film on each side.

\* Patient is positioned with the occlusal plane horizontal and the tab of the film placed on the occlusal surfaces of lower teeth ask the patient to close the teeth firmly together on the tab the beam is aimed directly through the contact areas at right angles to the teeth and film in horizontal plane and at approximate 5° - 8° downward in vertical plane. Occlusal film projection: Diagnostic Objectives of Occlusal Radiography

- To locate supernumerary, un erupted, and impacted teeth
  To localize foreign bodies in the jaws and floor of the mouth
- 3. To identify and determine the full extent of disease (e.g., cysts, osteomyelitis, malignancies) in the jaws, palate, and floor of the mouth

4. To evaluate and monitor changes in the midpalatal suture during orthodontic palatal expansion .

in the ducts of التحصي 5. To detect and locate sialoliths

sublingual and submandibular glands

## Types of occlusal projection

Maxillary occlusal projections
 Mandibular occlusal projections
 Maxillary occlusal projections include:
 a- Upper standard occlusal
 b- Upper oblique occlusal
 c- Vertex occlusal
 Image: Additional projections
 Image: Additional p



## • A - Upper standard occlusal

• This projection shows the anterior part of maxilla and upper anterior teeth.

## • The technique:

- 1. Patient position where the occlusal plane horizontal and parallel to the floor.
- 2. Film placed on to the occlusal surfaces of lower teeth and patient asked to bite together gently the film place centrally in the mouth (the long axis crossways).
- 3. X-ray tube positioned above the patient in the midline directed downward through the bridge of the nose at 65° - 70° to the film packet

B – Upper oblique occlusal

This projection shows the posterior part of maxilla and the upper posterior teeth.

#### The technique:

- 1. Patients position where the occlusal plane horizontal and parallel to the floor.
- 2. Film placed on the occlusal surfaces of lower teeth with long axis anterior posterior it placed to the side of the mouth under examination and patient asked to bite gently.
- 3. X-ray tube positioned at the side of patients face directed downwards through the cheek at  $65 - 70^{\circ}$  to the film.



Presentation title

## C-Vertex occlusal:

This projection shows a plan view of teeth bearing area of maxilla from above to assess the bucco - palatal position of un erupted canines.

## The technique:

- 1. The patient is seated with occlusal plane horizontal and parallel to the floor.
- 2. The film placed on the occlusal surfaces of lower teeth with its long axis anteroposteriorly and patient asked to bite on to it.
- 3. X-ray tube is positioned above the patient in the midline directed downwards through the vertex of the skull



## Mandibular occlusal projection:

a/ Lower 90° occlusal (true occlusal). b/ Lower standard **occlusal**. c/ Low oblique occlusal.

a/ Lower 90° occlusal (trueocclusal): This projection used to show a plan view of the tooth berging area of mandible and the floor of pre-neutr.

## \* The technique:

- 1. Patient tips his head backward as far as comfortable, where it is supported.
- 2. The film placed centrally into the mouth on the occlusal surfaces of lower teeth with long axis crossways and patient bite gently on the film.
- 3. X-ray tube placed below the patients chin in midline centering on imaginary line joining the first molar at 90° to the film.



## b/ Lower standard occlusal:

This projection is taken to show lower anterior teeth and anterior part of mandible.

- Technique:
- 1. Patient is seated with the head supported and occlusal plane horizontal and parallel to the floor.
- 2. Film placed centrally into the mouth and the long axis anterioposterior then asks him to bite on the film gently.
- 3. X-ray tube positioned in midline centering through the chin point at 45° to the film



### Lower oblique occlusal:

This projection shows the submandibular salivary gland on the side of interest.

\* The technique:

- 1. Patients head is supported and rotated away from the side under investigation and raised.
- 2. The film placed on occlusal surfaces of lower teeth over to the side under investigation with long axis anterior posteriorly then he bite on the film gently.
- 3. X-ray tube directed upwards and forwards toward the film from below and behind the angle of mandible and parallel to the lingual surface of the mandible





## Thank you for your kind attention



Radiology Oral Radiograph Anatomical landmarks

Lecture 6 3<sup>rd</sup> level

By: Dr. Yusra H. Al mukhtar

Department of oral and maxillofacial surgery

A number of anatomic landmarks are visible in dental radiographs.

Knowledge of the location and normal appearances of these landmarks is important in identification and orientation of radiographs. This knowledge is valuable to the dental officer in determining whether the area is normal or abnormal.

## Radiolucent vs. Radiopaque

Structures that are cavities, depressions or openings in bone such as a sinus, fossa, canal or foramen will allow x-rays to penetrate through them and expose the receptor (dental film).

\*These areas will appear radiolucent or black on radiographic images.

Structures that are bony in origin absorb or stop the penetration of the xrays and, therefore, do not reach the receptor.

\*These areas appear radiopaque or white on radiographic images. Some <sup>2</sup>

## NORMAL TOOTH

## ANATOMY

Tooth structures that can be viewed on dental images include the following: enamel, dentin, the denamo-enamel junction, and the pulp cavity. Cementum is not usually apparent radiographlly because cementum layer is so thin. **Enamel** is the densest structure found in the human body.

Enamel is the outermost radiopaque layer of the crown of a tooth **Dentin** is found beneath the enamel layer of a tooth and surrounds the pulp cavity. **Dentin** appears radiopaque and makes up the majority of the tooth structure. Dentin is not as radiopaque as enamel. **Dentino-Enamel Junction (DEJ) is the** junction between the dentin and the enamel of a tooth. The DEJ appears as a line where the enamel (very radiopaque) 3

meets the dentin (less radiopaque)

Pulp Cavity The pulp cavity consists of a pulp chamber and pulp canals. It contains blood vessels, nerves, and lymphatics and appears relatively radiolucent on a dental image



## **Supporting Structures**

The alveolar process, or

alveolar bone, serves as the supporting structure for teeth.

Anatomy of Alveolar bone

The anatomic landmarks of the alveolar process include the lamina dura, the alveolar crest, and the periodontal ligament space.
Lamina Dura Description. The lamina dura is the wall of the tooth socket that surrounds the root of a tooth. The lamina dura is made up of dense cortical bone

**Appearance**. On a dental image, the lamina dura appears as a dense radiopaque line that surrounds the root of a tooth.

The alveolar Crest Description.

The alveolar Crest Description is the most coronal portion of alveolar bone found between teeth. The alveolar crest is made up of dense coruce continuous with the lamina dura. Appearance. On a dental image, the alveolar crest appears radiopaque and is typically located 1.5 to 2.0 mm below the junction of the crown and surfaces (the the root cementoenamel junction).

**Periodontal Ligament Space** 

### **Description.**

The periodontal ligament space (PDL space) is the space between the root of the tooth and the lamina dura. The PDL space contains connective tissue bers, blood vessels, and lymphatics.

PDL space appears as a thin radiolucent line around the root of

**Appearance.** On a dental image, the

Presentation title

In the healthy periodontium, the PDL space appears as a continuous radiolucent line of uniform thickness.



10=Alv. Cresrt 3=lamina deura 4=PDL

#### Types of Bone

The composition of bone in the human body can be described as either cortical or cancellous **Cortical bone**, also referred to as compact bone, is the dense outer layer of bone **Cancellous bone** (also called trabecular bone) is the soft, spongy bone located between two layers of dense cortical bone the trabeculae in the **anterior** maxilla are typically thin and numerous in the **posterior maxilla** the trabecular pattern is usually quite similar to that in

the anterior maxilla, although the marrow spaces may be slightly larger.



#### In the anterior mandible

the trabeculae are somewhat thicker than in the maxilla, resulting in a coarser pattern بشكل خشن, with trabecular plates that are oriented more horizontally

#### In the posterior mandible

the periradicular trabeculae and marrow spaces may be comparable to those in the anterior mandible but



## Some terms of dental radiographs

## **Prominences of Bone**

Prominences of bone are composed of dense cortical bone and appear radiopaque on dental images. Process: A marked prominence or projection of bone; an example is the coronoid process of the mandible

\*Ridge: A linear prominence or

projection of bone; an example is

the external oblique ridge of the

mandible.

\*Spine: A sharp, thorn-like

projection of bone; an example is the anterior nasal spine.

\*Tuberosity: A rounded prominence

## **Spaces and Depressions in Bone**

Spaces and depressions in bone do not resist the passage of the x-ray beam and appear radiolucent on dental images.

Four terms can be used to describe the spaces and depressions in bone viewed in maxillary and mandibular periapical images, as follows.\* **Canal:** A tube like passageway through bone that contains nerves and blood vessels; an example is the mandibular canal

Foramen: An opening or hole in bone that permits the passage of nerves and blood vessels; an example is the mental foramen of the mandible.

**Fossa:** A broad, shallow, scooped-out or depressed area of bone; an example is the submandibular fossa of the mandible.

Sinus: A hollow space, cavity, or recess in bone; an example is the maxillary sinus

Miscellaneous Terms Two other general terms can be used to describe normal landmarks viewed on a dental image, as follows:



**Septum:** A bony wall or partition that divides two spaces or cavities. An example is the nasal septum. **Suture**: An immovable joint that represents a line of union between adjoining bones of the skull. An example is the median palatine suture of the maxilla

## Normal anatomical landmarks

## Bony Landmarks of the Maxilla

## **Incisive Foramen**

**Description**. The incisive foramen (also known as the nasopalatine foramen) is an opening or hole in bone located at the midline of the anterior portion of the hard palate.

The nasopalative nerve exits the maxilla through the inclusive foramen.

#### Appearance.

On an anterior maxillary periapical image, the incisive foramen appears as a small, ovoid or round radiolucent area located between the roots of the maxillary central incisors.

#### Median Palatal Suture

Description. The median palatal suture is the immovable joint between the two palatine processes of the maxilla. Appearance. On an anterior maxillary periapical image, the median palatal suture appears as a thin radiolucent line between the maxillary central incisors



## Median Palatal Suture

- **Description**. The median palatal suture is the immovable joint between the two palatine processes of the maxilla. **Appearance**. On an anterior maxillary periapical image, the median palatal suture appears as a thin radiolucent line between the
- maxillary central incisors



Lateral Fossa **Description** The lateral ossa (also known as the canine fossa) is a smooth, depressed area of the maxilla located between maxillary canine and lateral incisors. **Appearance**. On an anterior maxillary periapical image, the lateral fossa appears as a radiolucent area between the maxillary canine and lateral

incisor



## Nasal Cavity

**Description**. The nasal cavity (also known as the nasal fossa) is a pear-shaped compartment of bone located superior to the Maxilla **Appearance.** On an anterior maxillary periapical image, the nasal cavity appears as a large, radiolucent area superior to the maxillary incisors



Nasal Septum **Description**. The nasal septum is a vertical bony wall or partition that divides the nasal cavity into the right and left nasal fossae (fossae is the plural of fossa) **Appearance**. On an anterior maxillary periapical image, the nasal septum appears as a vertical radiopaque partition that divides the nasal cavity.



Floor of Nasal Cavity **Description**. The floor o the nasal cavity is a bony wall Appearance. On an anterior maxillary periapical image, the floor of the nasal cavity appears as a **dense radiopaque** band of bone superior to the maxillary incisors



**Anterior Nasal Spine Description.** The anterior nasal spine is a sharp projection of the maxilla located at the anterior and inferior portion of the nasal cavity. **Appearance**. On an anterior maxillary periapical image, the anterior nasal spine appears as a V-shaped radiopaque area located at the intersection of the

floor of the nasal cavity and the

nasal septum.



Maxillary Sinus **Description.** The maxillary sinuses are paired cavities or compartments of bone located within the maxilla Appearance. On a posterior maxillary periapical image, the maxillary sinus appears as a radiolucent area located superior to the apices of maxillary premolars and molars



**Septa Within Maxillary Sinus Description.** Bony septa (septa is the plural of septum) may be seen within the maxillary sinus. Septa are bony walls or partitions that appear to divide the maxillary sinus into compartments. Appearance. On a posterior maxillary periapical image, the septa appear as **radiopaque lines** within the maxillary sinus



Inverted Y **Description**. The term inverted Y refers to the intersection of the maxillary sinus and the nasal cavity as viewed on a dental mage. **Appearance.** On a maxillary canine periapical image, the inverted Y appears as a radiopaque upside-down Y formed by the intersection of the lateral wall of the nasal fossa and the anterior border of the maxillary sinus.



**Maxillary Tuberosity Description**. The maxillary tuberosity is a rounded prominence of bone that extends posterior to the third molar region. **Appearance.** On a posterior maxillary periapical image, the maxillary tuberosity appears as a radiopaque bulge distal to the third molar region.



**Zygomatic Process of Maxilla Description**. The zygomatic process o the maxilla is a bony projection of the

maxilla that articulates with the zygoma, or malar bone.

The zygomatic process of the maxilla is composed of dense **cortical bone**. **Appearance**. On a posterior maxillary periapical image, the zygomatic process of the maxilla appears as a **Jshaped or U-shaped radiopacity** located superior to the maxillary first molar region



# Bony Landmarks of the Mandibl

- Genial Tubercles Description.
- Genial tubercles are tiny bumps of bone that serve as attachment sites for the genioglossus and geniohyoid muscles.
- Appearance. On a mandibular periapical image, genial tubercles appear **as a ring-shaped radiopacity** inferior to the apices of the mandibular incisors.



## Lingual Foramen Description.

The lingual foramen is a tiny opening or hole in bone located on the internal surface of the mandible. The lingual foramen is located near the midline and is surrounded by genial tubercles. **Appearance**. On a mandibular periapical image, the lingual foramen appears as a small, radiolucent dot located inferior to the apices of the mandibular incisors.



#### Mental Ridge Description.

The mental ridge is a linear prominence of cortical bone located on the external surface of the anterior portion of the mandible **Appearance.** On a mandibular periapical image, the mental ridge appears as a **thick radiopaque band** that extends from the premolar region to the incisor region

Mental Fossa Description. The mental fossa is a scooped-out, depressed area of bone located on the external surface of the anterior mandible Appearance. On a mandibular

periapical image, the mental fossa appears as **a radiolucent area** above the mental ridge





## Mental Foramen Description.

The mental foramen is an opening or hole in bone located on the external surface of the mandible in the region of the mandibular premolars. Blood vessels and nerves that supply the lower lip exit through the mental foramen. Appearance. On a mandibular periapical image, the mental foramen appears as a small, ovoid or round radiolucent area

located in the apical region of the

mandibular premolars.



## Mandibular Canal Description.

The mandibular canal is a tubelike passageway through bone that travels the length of the mandible.

The mandibular canal extends from the mandibular foramen to the mental foramen and houses the inferior alveolar nerve and blood vessels.

Appearance. On a mandibular periapical image, the mandibular canal appears as **a** radiolucent band. Two thin radiopaque lines that represent the cortical walls of the canal outline the mandibular canal. The mandibular canal appears below or superimposed over the apices of the mandibular molar teeth



## Mylohyoid Ridge Description.

The mylohyoid ridge (also known as the internal oblique ridge) is a linear prominence of bone located on the internal surface of the mandible The mylohyoid ridge extends from the third molar region do and forward to the second premolar area. The mylohyoid ridge serves as an attachment site for a muscle of the same name.

**Appearance**. On a mandibular periapical image, the mylohyoid ridge appears as a **dense radiopaque** band that extends downward and forward from the third molar region at the level of the apices of the posterior teeth.



**External Oblique Ridge Description**. The external oblique ridge (also known as the external oblique line) is a linear prominence of bone located on the external surface of the body of the mandible. The anterior border of the ramus ends in the external oblique ridge **Appearance**. On a mandibular molar periapical image, the external oblique ridge appears as a radiopaque band extending downward and forward from the anterior border of the ramus of the mandible



Submandibular Fossa Description. The submandibular fossa (also known as the mandibular fossa or submaxillary fossa) is a scooped-out, depressed area of bone located on the internal surface of the mandible inferior to the mylohyoid ridge. The submandibular salivary gland is found in the submandibular fossa. **Appearance.** On a mandibular periapical image, the submandibular fossa appears as a radiolucent area in the molar region below the mylohyoid ridge.



**Coronoid Process Description.** The coronoid process is a marked prominence of bone on the anterior ramus of the mandible. The coronoid process serves as an attachment site for one of the muscles of mastication **Appearance.** The coronoid process is not seen on a mandibular periapical image but may appear on a maxillary molar periapical image. The coronoid process appears as a triangular radiopacity superimposed over, or inferior to, the maxillary tuberosity region



Inferior border of mandible is the lower most part of the mandible. Appears as dense broad radiopaque band of bone



Radiographic appearance of restorative materials:

**Radiopaque restorative materials:** Gold, Silver amalgam, Zinc oxide – eugenol, Zinc phosphate cement, Gutta – percha, Silver points, Metal bands & crowns, Metal wires & dental implants **R**adiolucent restorative materials: Acrylic, Silicates, Calcium hydroxide pastes, & Porcelain.







## Thank you for your kind attention





There are many developmental and acquired anomalies that can affect the teeth and facial skeleton so they classified into: Anomalies of the teeth and Craniofacial anomalies. The diagnosis of them based on both the clinical and radiographic findings.





Presentation title

## Anomalies of the teeth

1- Developmental teeth anomalies: These include abnormalities of the teeth
in: Number, Structure, Size, Shape

(morphology), and Eruption.

Abnormalities in number: - Missing teeth (Hypodontia) It's a condition at which the patient has missing one or few teeth as a result of their failure to develop.

when numerous teeth are absent the condition called (oligodontia) and the failure of all teeth to develop called (anodontia). It could happen in Ectodermal Dysplasia د النسية الانتراكية.

I was a facture of Missing to the most

### Hyperdontia

It's a condition of having supernumerary teeth, or teeth which appear in addition to the regular number of teeth. The most common supernumerary tooth is a mesiodens, which is a mal-formed, peg-like tooth that occurs between the maxillary central incisors, Fourth and fifth molars (paramolar, or distomolar) that form behind the third molars are another kind of supernumerary teeth.

It could be associated with **Cleidocranial Dysplasia**السي القحف. The imaging features of supernumerary teeth are variable. **They may appear entirely normal in both size and shape or they may be smaller and conical shape**.



Panoramic radiograph showing multiple Supernumerary premolars

Mesiodens

Abnormalities in structure: The Abnormalities in teeth structures are subdivided into: 1- Genetic defect: -Amelogenesis imperfect Genetic disturbances in enamel formation leading to altered morphology of enamel. There is normal dentin and pulp formation. Imaging features shows square-shaped crown, thin enamel and absence of cusps,


Dentinogenesis imperfecta Is a genetic anomaly involving the **dentin** in both deciduous and permanent dentition Imaging features show a marked constriction at cervical region of the tooth crown with pulp champer obliteration and short blunt roots. There is another genetically inherited abnormality that affects dentin called Dentin dysplasia



**Regional** Odontodysplasia ( ghost teeth) Its a rare condition in which both enamel and dentin are hypoplastic and hypocalcified. Imaging feature described as شبح.ghost-like"appearance" The pulp chambers are large and the root canals are wide with very thin enamel and dentin.

2- Acquired defects: -Turner hypoplasia It's a frequent pattern of enamel defects seen in permanent teeth secondary to periapical inflammatory disease of the overlying deciduous tooth. The altered tooth is called (Turner's tooth). Imaging features of the involved region of the crown may appear as an illdefined radiolucent region



#### Congenital syphilis It's a dental hypoplasia that results from direct infection of the developing tooth by spirochete of syphilis, involves the permanent

developing toour by spirochete of syphilis, involves the permanent incisors that called (Hutchinson's teeth) and first molars that called (mulberry molars) المراس التوت. Imaging features have a characteristic shapes of the affected incisor and molar crowns



## Abnormalities in size

Macrodontia (large teeth) It's a condition in which the teeth are abnormally large, rarely affects the entire dentition. Often a single tooth or a group of teeth may be involved. Imaging features reveal the increased size of the teeth. The shape of the tooth is usually normal, but some cases may be distorted. It associated with crowding, malocclusion, or impaction



## Microdontia (small teeth)

It's a condition in which teeth appear smaller than normal. In the generalized form, all teeth are involved. In the localized form, only single or few teeth are involved. The most common teeth affected are the upper lateral incisors and third molars. Imaging features of the affected teeth are frequently small and malformed



Abnormalities in shape (morphology): -**Fusion** Two teeth joined together into a single anatomic crown (union of two separated tooth germ). Fusion is more common in anterior teeth of both the deciduous and permanent dentitions. Imaging features of fused teeth show unusual shape, size, and pulp chamber or root canal



### **Gemination**

Single tooth germ divided into two teeth joined together (single root with two or enlarged crowns).
Imaging features reveal the altered shape of the hard tissue and pulp chamber of the geminated tooth

#### **Concrescence**

Is union of two adjacent teeth by cementum only. Maxillary third molar frequently involved. Imaging features reveal concrescence teeth may be in close contact or are simply superimposed.





## Dilaceration

Is a deviation or sharp bend in the linear relationship of a tooth crown to its root; Imaging features is readily apparent on an intraoral radiograph when the roots are bending mesially or distally, buccally or lingually.





## Dens Invaginatus and Dens Evaginatus

## **Dens invaginatus**

Is infolding of the enamel surface into the interior of a tooth crown or the root . Imaging features show more radiopaque than the surrounding tooth structure, poorly defined root,

## Dens evaginatus

Is the outpouching تدفق of the enamel on the occlusal surface. **Imaging features shows an extension of a dentin tubercle on the occlusal surface covered with radiopaque enamel.** 



#### لؤلؤة الميناEnamel pearl

It's small spherical enamel masses (enamelomaالررمينا) located at the root of the molars and are found in 3% of the population. **Imaging features of the enamel pearl appears smooth, round radiopaque structure**.



#### Taurodontism

It's a condition found in the molar teeth whereby the body of the tooth and pulp chamber is enlarged vertically with short roots, the floor of the pulp and the furcation of the tooth is moved apically. Imaging features is the elongated pulp chamber and the more apically positioned furcation, shortened roots with long crown.

#### Talon cusp:

It's an Accessory cusp like structure projecting from the cingulum area or cementenamel junction of the maxillary or mandibular anterior teeth. Imaging features show a distinct radiopaque image of talon cusp on the crown of the involved tooth. Abnormalities in Eruption of Teeth:

Transposition is the condition in which two adjacent teeth have exchanged positions in the dental arch. Imaging features
reveal transposition when the teeth are not in their usual sequence in the dental arch

Presentation title

Premature Eruption (natal and neonatal teeth) The teeth erupted in the oral cavity at the time of birth are called as 'natal teeth' and teeth erupting prematurely in first 30 days of life are called as 'neonatal teeth'. Imaging features the roots are not seen on the radiograph and the teeth are very small.



Delayed Eruption (Impacted Teeth) permanent teeth are observed to be delayed in eruption forming Partially or completely impacted teeth, is more commonly in mandibular third molar, followed by maxillary canine and maxillary third molar. Imaging features of impacted mandibular third molar show mesioangular , distoangular , vertical or horizontal impaction. 2-Acquired teeth Abnormalities
Attrition: is physiologic wearing of teeth (occlusal contacts). The imaging appearance is flat incisal or occlusal surface.

- Abrasion is the non physiologic wearing of teeth (friction with a foreign toothbrush and dental floss , pipe ,...).
   Imaging appearance is defects at the cervical level of teeth
- Erosion (chemical action). Imaging features appear as radiolucent defects on the crown
- Resorption is the removal of tooth
  structure (internal or external). Imaging
  features for external root resorption are
  smooth loss apical and cervical regions
  with blunt root apex, while internal
  resorption round, oval radiolucent within
  the root or crown



- Secondary dentin additional dentin deposited. Imaging features is a reduction in size of the normal pulp



Pulp stones (foci of calcification in the dental pulp). The imaging appearance is radiopaque structures within pulp, Pulpal sclerosis is another form of pulp calcification, but it diffuse to larger area. - Hypercementosis is excessive

deposition of cementum on the

tooth roots. Imaging is an

excessive buildup of cementum<sup>8</sup>

Presentation title

# Craniofacial anomalies



**Craniofacial anomalies** The craniofacial anomalies are usually first discovered in infancy or childhood. Some are caused by genetic mutations, others result from environmental in factors, and a third group are multifactorial.

Cleft lip and palate is one of these anomalies

### Cleft Lip and Palate

**Cleft lip** occurs due to failure of union of medial and lateral maxillary processes. While, **cleft palate** (CP) develops from a failure of fusion of the lateral palatal shelves Cleft lip and palate together (CL/P) is either unilateral or bilateral. In both CL/P and CP, the palatal defects interfere with speech and swallowing

Multiple radiographic procedures are performed on patients with CL/P throughout childhood and adolescence. These may include panoramic, periapical, occlusal, and cephalometric radiographs, as well as multidetector computed tomography and, more recently, **cone-beam imaging.** Imaging **Features** appeare as well-defined vertical

radiolucent defect in the alveolar process with numerous dental anomalies ( absence of the maxillary lateral incisor, presence of supernumerary teeth, enamel hypoplasia, malformed teeth, delay eruption with hypodontia in both arches).









## Thank you for your kind attention



## Radiology

Panoramic Radiography 8 lecture 3<sup>rd</sup> level

By: Dr. Yusra H. Al mukhtar

Department of oral and maxillofacial surgery

## Panoramic imaging (also called pantomography)

**Panoramic imaging** 

(also called pantomography)

is a technique for producing a single tomographic image of the facial structures that includes both the maxillary and mandibular dental arches and their supporting structures.

## Principles of panoramic radiography

Paatero and Numata were the first to describe the principles of panoramic radiography.

x-ray source rotate around the patient's head and in opposite direction to the rotation of image receptor and collimator.

Lead collimators in the shape of a slit, located at the x-ray source and at the image receptor, limit the central ray to a narrow vertical beam.





## Indications

- 1. Overall evaluation of dentition
- 2. Evaluation of intraosseous pathology such as cysts, tumors and infections.
- 3. Gross evaluation of tempromandiular joints
- 4. Evaluation of impacted teeth.
- 5. Evaluation of permanent **teeth** eruption and mixed dentition.
- 6. Dentomaxillofacial trauma such as **fracture.**
- 7. Developmental disturbances of maxillofacial skeleton

## Advantages of Panoramic radiograph

### **Advantages of Panoramic**

- 1 radioadappyerage of the facial bones and teeth
- 2. Low patient radiation dose( compared to full mouth survey and CBCT)
- Convenience of the examination for the patient
   Can be used in patients with trismus (unable to open their mouths) or patient untolerate intraoral film.
- 5. Short time required to make a panoramic image, usually in the range of **3 to 4 minutes** (This includes the time necessary for positioning the patient and the
- actual exposure cycle.)
  6. A useful visual aid in patient education and case presentation
  7. Easy radiographic technique

**Advantages** of Panoramic radiograph

## Disadvantages

1. Lower resolution images that don't provide fine details provided by intraoral periapical radiographs. Thus it is not as useful as periapical radiography for detecting small carious lesions, fine structure of the marginal periodontium, or periapical disease. The proximal surfaces of premolars also typically overlap

 2. Unequal magnification and

 geometric distortion across the

 image.نتكبير غير المتكافئ

3. The presence of overlapping structures, such as the cervical spine, can hide odontogenic lesions, particularly in the incisor regions.

4. Important objects may be situated outside the plane of focus (image layer) and may appear distorted or not present at all.

5. Difficult to image both jaws when patient has sever maxillomandibular discrepancy.تناقض







## natomical landmarks in the panoramic radiograph

- 1. Pterygomaxillary fissure
- 2. Posterior border of maxilla
- 3. Maxillary tuberosity
- 4. Maxillary sinus
- 5. Floor of the maxillary sinus
- 6. Medial border of maxillary sinus/ 16.
  - lateral border of the nasal cavity
- 7. Floor of the orbit
- 8. Infraorbital canal
- 9. Nasal cavity
- 10. Nasal septum

- Floor of the nasal cavity
   Anterior nasal spine
   Incisive foramen
   Hard palate/floor of the nasal cavity
   Zygomatic process of the maxilla
   Zygomatic arch
   Articular eminence
   External auditory meatus
- Styloid process
   Mandibular condyle
- 21. Sigmoid notch

Coronoid process
 Posterior border of rai
 Angle of mandible
 Hyoid bone
 Inferior border of mand
 Mental foramen
 Mandibular canal
 Cervical vertebrae
 Epiglottis

## Focal Trough حوض بؤري or IMAGE LAYER

—The image layer is a three-dimensional curved zone منطقة منحنية ثلاثية الابعاد, where the structures lying within this layer are reasonably well defined on final panoramic image.

-The structures seen on a panoramic image are **primarily those located within the image layer.** 

Objects outside the image layer are blurred عبر واضح, magnified معر, or reduced in size and are sometimes distorted منحرف to the extent of not being recognizable

The focal trough is the area in which structures will appear most sharply and clearly.



**Real , Double and Ghost images** —Because of the rotational nature of xray source and receptor, the x-ray beam intercepts **some anatomic structures twice .** Depending on **their location**, **objects** may cast three different types of images:

- 1. Real images: object that lie between the center of rotation and the receptor form a real image( all the objects whin focal trough cast relatively sharp images). (figure D)
- 2. Double images: objects that lie posterior to the center of rotation and that intercepted twice by the xray beam form double images (figure E).

Presentation title

3. Ghost images: objects that located between the x-ray source and center of rotation, can cast ghost images. The ghost image appear on the opposite side of it's true anatomic location and at higher level. (figure F)





FIG. 11-9 Orthoralix 8500 panoramic machine. (Courtesy Orthoralix 8500, KaVo Dental Corp., Gendex Dental Systems, Lake Zurich, IL.) FIG. 11-10 Proline XC panoramic machine. (Courtesy Planmeca Inc., Wood Dale, III.)

## Patient Positioning and Head Alignment

To obtain diagnostically useful panoramic radiographs, it is necessary to properly **prepare patients and to position their heads carefully in the image layer.** 

1. Dental appliances, earrings, necklaces, hairpins, and any other metallic objects in the head and neck region should be removed.

2. **Demonstrate** the machine to the patient by cycling it while **explaining** the need to remain still during the procedure. This is particularly true **for children**, who may be anxious. Children should be instructed to look forward and to not follow the tube head with their eyes.

## Patient Positioning and Head Alignment

- 3. The anteroposterior position of the patient head is achieved typically by place the incisal edges of their maxillary and mandibular incisors into a notched positioning device (the biteblock).
  - 4. The midsagittal plane must be centered within the image layer of the particular x-ray unit. (Patient's

5. The patient's chin and occlusal plane must be properly positioned to avoid distortion. The occlusal plane is aligned so that it is lower anteriorly, angled 20 to 30 degrees below the horizontal. A general guide for chin positioning is to place the patient so that a line from the tragus of the ear to the outer canthus of the eye is parallel with the floor. (Frankfort plane)

6. Patients are positioned with their **backs and spines as erect** as possible and their **necks extended**.

7. Ask the patient to swallow and hold the tongue on the roof of the mouth. This raises the dorsum of the tongue to the hard palate, eliminating the air space and providing optimal visualization of the pices of the maxillary teeth

Frankfort plane

Midsagittal plane

Most common errors in panoramic radiograph 1. Placement of the patient either too far anterior or posterior results in significant dimensional in the انحر افات كبيرة في ابعاد المور in the images. Too far posterior results in magnified مكبر mesiodistal dimensions through the anterior sextants and resulting " fat " teeth (see Figure 11-7,F)Too far anterior (see Figure 11-7, D).



FIG. 11.7 A. Mandale supporting a metal ring positioned at the center of the tocal trough. The inclusive ages of the mandibular feelth are indexed by a bite rod-positioning device. The mandale is positioned at the center of the trough B, Resultant paneramic radiograph C. Mandale and ring positioned smith anterior to the tocal trough. The inclusive ages of the test and ring and ring bostened in the test and ring and ring the northental minimum sector to the trough. D, Resultant paneramic radiograph devices the trough of the test are anterior to the trough of the test are anterior to the trough of the test and ring and mandale test. E. Mandale and ring posterior to the trough of the test to the focal trough. The inclusive age of the test are also posterior to the trough S. Resultant parenamic radiograph demonstrating the horizontal minimum rest to the focal trough. The inclusive age of the test are also posterior to the trough S. Resultant parenamic radiograph demonstrating the horizontal manenamic radiograph demonstrating the horizontal magnetication of both ming and manenamic radiograph demonstrating the horizontal magnetication of both ming and manenamic rest.

2. Failure to position the midsagittal plane lead to rotational midline results in a radiograph showing right and left sides that are unequally magnified in the horizontal dimension . Poor midline positioning is a common error, causing horizontal distortion in the posterior regions,, excessive tooth overlap in the premolar regions and on occasion, nondiagnostic, clinically unacceptable

✤ A simple method for evaluating the degree of horizontal distortion of the image is to compare the apparent width of the mandibular first molars bilaterally.

The Smaller side is too close to the receptor and the larger side is too close to the x-ray source



3. If the chin is tipped too high, مائلة the occlusal plane on the life occlusal plane on the radiograph appears flat or inverted, and the image of the mandible is distorted (Fig. 11-12, A). In addition, a radiopaque shadow of the hard palate is superimposed on the roots of the maxillary teeth. While If the chin is tipped too low, the teeth become severely overlapped, the symphyseal region of the mandible may be cut off the film, and both mandibular condyles may be projected off the superior edge of the film (Fig. 11-12, **B**).



— FIG. 11-12 Panoramic radiographs demonstrating poor patient head alignment. A, The chin and occlusal plane are rotated upward, B, The chin and occlusal plane are rotated downward.

4. improperly positioned patient. Patients don't sit straight and align or don't stretch their back leading to large radiopaque region in the middle (" spine-shadow ghost "



# Thank you for your kind attention



Presentation title
#### **CEPHALOMETRIC PROJECTIONS**

Lecture 9 3<sup>rd</sup> level

By: Dr. Yusra H. Al mukhtar

Department of oral and maxillofacial surgery

# **Cephalometric projections**

- Cephalometric projections are standardized projections for imaging of craniofacial region and made with a Cephalostat, which helps to maintain a constant relationship between the skull, the receptor, and the x-ray beam.
- A cephalometric projection is made with a long source-to-object distance of 5 ft; this large distance minimizes image magnification. The object-to-receptor distance is typically 10 to 15 cm. These projections may be made using film or digital receptors.
- There are 2 main types of cephalometric projections, these include:
- 1. True lateral cephalometric projection
- 2. Postero-anterior cephalometric projection





### True lateral cephalometric radiograph Indications:

- 1. A pretreatment record (providing a baseline record prior to the placement of appliances, particularly where movement of the upper and lower incisors is planned)
- 2. Evaluate the anteroposterior (AP) relationships between the maxilla, mandible, and cranial base, in addition to soft-tissue relationships.
- 3. Monitor progress of orthodontic treatment and treatment outcomes.
- 4. Proceed with orthognathic surgical treatment planning.

### Image Receptor (film) and Patient Placement

 The image receptor is positioned parallel to the patient's midsagittal plane. In cephalometric radiography, the patient is placed with the left side toward the image receptor. The patient is asked to occlude in his normal intercuspation position





### Position of the Central X-Ray Beam

 The central beam is perpendicular to the midsagittal plane of the patient and the plane of the image receptor and is centered over the external auditory meatus.



# Image interpretaion

- Exact superimposition التراكب الدقيق of right and left sides is impossible because the structures on the side near to the image receptor are magnified less than the same structures on the side far from the image receptor.
- Lateral cephalometric radiograph should first be evaluated for possible variants that might simulate disease before cephalometric analysis.

To ensure that all anatomic structures are assessed لضمان تقييم, a systematic visual evaluation should be followed.يجب اتباع تقييم مرئي منهجي

• Step 1. Evaluate the base of the skull and calvaria. (The calvaria is composed of 5 bones: Frontal, parietal, occipital, temporal, and sphenoid greater wings bones) Identify the mastoid air cells, ( The mastoid air cells are thought to protect the delicate structures of the ear, regulate ear pressure and possibly protect the temporal bone during trauma.) clinoid processes, sella turcica, sphenoid sinuses, and roof of the orbit.



#### To ensure that all anatomic structures are assessed a systematic visual evaluation should be followed.

 Step 2. Evaluate the upper and middle face. Identify the orbits, sinuses (frontal, ethmoid, and maxillary), zygomatic processes of the maxilla, anterior nasal spine, and hard palate (floor of the nose). Evaluate the soft tissues of the upper and middle face, nasal cavity (turbinates), soft palate, and dorsum of tongue

# To ensure that all anatomic structures are assessed, a systematic visual evaluation should be followed.

- Step 3. Evaluate the lower face. Follow the outline of the mandible: from the condylar and coronoid processes; to the rami, angles, and bodies; and finally to the anterior mandible. Evaluate the soft tissue of the lower face
- Step 4. Evaluate the cervical spine, airway, and area of the neck. Identify each individual vertebra, and assess the general alignment of the vertebrae. Assess soft tissues of the neck, hyoid bone, and airway
- Step 5. Evaluate the alveolar bone and teeth

# Postero-anterior cephalometric projection

 It is standardized and reproducible view indicated for the assessment of facial asymmetries and assessment of orthognathic surgery outcomes involving the patient's midline or mandibular-maxillary relationship.



# **Technique and positioning:**

- 1. The head stabilizing apparatus of the cephalostat is rotated through 90°.
- 2. The patient's head tipped forwards and with the radiographic baseline, i.e. in **the forehead-nose position**.
- 3. The head is immobilized within the apparatus by inserting the plastic ear rods into the external auditory meatus.
- 4. The X-ray beam is horizontal with the central ray centered through the cervical spine at the level of the rami of the mandible

# Definition of Cephalometric Landmarks Skeletal Landmarks

- 1. Porion (Po): Most superior point of the external auditory canal
- 2. Sella (S): Center of the hypophyseal fossa
- 3. Nasion (N): Frontonasal suture
- 4. Orbitale (Or): Most inferior point of the infraorbital rim
- 5. PNS: Tip of the posterior nasal spine
- 6. **ANS**: Tip of the anterior nasal spine
- 7. A point (A): Deepest point of the anterior border of the maxillary alveolar ridge concavity
- 8. B point (B): Deepest point in the concavity of anterior border of the mandible



# Definition of Cephalometric Landmarks

- 9. Pogonion (Po): Most anterior point of the symphysis
- On the symphysis
   Outline between pogonion and menton
- 11. Menton (M): Most inferior point of the symphysis
- 12. Gonion (Go): Most convex point along the inferior border of the mandibular ramus



# Soft Tissue Landmarks

- 1. Soft tissue glabella: Most anterior point of the soft tissue covering the frontal bone
- 2. Soft tissue nasion: Most concave point of soft tissue outline at the bridge of the nose
- 3. Tip of nose: Most anterior point of the nose
- 4. Subnasale: Soft tissue point where the curvature of the upper lip connects to the floor of the nose
- Soft tissue A point: Most concave point of the upper lip between the subnasale and the upper lip point



= soft-tissue ....



# Soft Tissue Landmarks

- 6. Upper lip: Most anterior point of the upper lip
- 7. Lower lip: Most anterior point of the lower lip
- 8. Soft tissue B point: Most concave point of the lower lip between the chin and lower lip point
- 9. Soft tissue pogonion: Most anterior point of the soft tissue of the chin
- 10. Soft tissue gnathion: Midpoint of the chin soft tissue outline between the soft tissue pogonion and soft tissue menton
- 11. Soft tissue menton: Most inferior point of the soft tissue of the chin













## Thank you for your kind attention



#### **EXTRA ORAL RADIOGAPHS**

Lecture 10 3<sup>rd</sup> level

By: Dr. Yusra H. Al mukhtar

Department of oral and maxillofacial surgery

## Extra oral radiographic examination

• Extra oral radiographs include all views made of orofacial region with film positioned extra orally.

• The dentists often used these views to examine area not fully covered with **intra oral** films or to visualize **skull** and **facial structures** 

#### THE MOST IMPORTANT AND COMMON USED PROJECTIONS IN DENTISTRY

1-PANORAMIC RADIOGRAPHS 2-CEPHALOMETRIC RADIOGRAPHS

#### **•SKULL PROJECTIONS**

°1-POSTEROANTERIOR PROJECTION

°2-WATERS'PROJECTION (INCLINED PA,)

°3-REVERSE-TOWNE'SPROJECTION

°4-SUBMENTOVERTEX PROJECTION

#### MANDIBULAR OBLIQUE LATERAL PROJECTION 1-MANDIBULAR BODY PROJECTION 2-MANDIBULAR RAMUS PROJECTION

#### •TEMPROMANDIBULAT-JOINT-PROJECTIONS

- 1-TRANSCRANIAL PROJECTION
- ° 2-TRANSORBITAL PROJECTION
- 3-TRANSPHARYNGEAL PROJECTION

## Panoramic radiographic

- it is produces a wide single image that shows maxillofacial region including maxilla, mandible and the adjacent structures on a single film.
- It is a form of 'tomography مقطعي', which is imaging by sectioning the body structures.
- The panoramic technique utilizes extra oral radiation source and the film is also positioned outside the patient's mouth in **a flexible or rigid cassette**
- This radiographic technique is widely utilized by the dentists to **evaluate overall health of maxillofacial structures.**
- It helps in the evaluation of trauma and fracture of all parts of mandible except in the anterior region





#### Cephalometrics

- is the study of the relationship of osseous components and the overlying soft tissue of the facial skeleton by means of standardized imaging.
- The identification of anatomical landmarks and the subsequent construction of lines between them help in getting tracings or cephalograms.
- The lateral cephalometric is the most commonly used with orthodontic treatment.
- Comparison of serial cephalograms of the same patient at different times can provide growth and development estimates.
- Such comparisons are best made and are reliable only if cephalometric images are taken under exactly the same





## **Skull Projections**

Radiographic examination of the skull requires patience مسر, attention to detail الممارسه لتحقيق نتائج مرضيه, and practice الممارسه لتحقيق نتائج مرضيه, and practice satisfactory results.

#### **POSTEROANTERIOR PROJECTION**

- The straight posteroanterior (PA) projection is so named because the x-ray beam passes in a posterior to anterior direction through the skull.
- \*This projection is used to examine the skull for disease, trauma, or developmental abnormalities.
- \* It also provides a good record for detecting progressive changes in the mediolateral dimensions of the skull, including asymmetric growth.

\*In addition, the PA projection offers good visualization of facial structures, including the frontal and ethmoid sinuses, nasal fossae, and orbits




## WATERS' PROJECTION (Inclined PA)

- \*The Waters' projection (**also called the occipitomental projection**) is a variation of the PA view.
- It is particularly useful for evaluating the maxillary sinuses.
- • \* In addition, it demonstrates the frontal and ethmoid sinuses, the orbit, the zygomaticofrontal suture, and the nasal cavity.
- \*It also demonstrates the position of the coronoid process of the mandible between the maxilla and the zygomatic arch





#### Representative image obtained from the posteroanterior skull projection (tragocanthal line parallel), LC, laminacribrosa; CG, crista galli; FS, frontal sinus; PCF, posterior cranial fosta;

MCF, middle cranial lossa (petrous temporal); ACF, anterior cranial fossa, Mx, maxilla; MnR, mandibular ramus; MnB, mandibular body;

MF, mental foramen; ENC, inferior natal conchae, CP, peronoid process of

mandible, MxS, maxillary sinus; UC, lacrimal canal, MNC, middle nasal

conchae; Ll, linea innominata l'innominate line1; SS, sphenold sinus; ES,

ethmoid sinus; SM, supraorbital margin, ZFS, sygomatico/rental suture;

NS, nasal septam; HP; hard palate.

## **REVERSE-TOWNE'SPROJECTION**

• \*The reverse-Towne's projection is used to examine radiographically a patient **suspected of having a condylar fracture of the neck.** 

• \*This projection is particularly suitable for **revealing a medially displaced condyle**.

• The reverse-Towne's projection **also reveals the posterolateral wall of the maxillary antrum** 





Representative image obtained from the reverse
Towne projection. CN, condylar neck; CP, superimposed
coronoid process
and ascending ramus of mandible; ZA, zygomatic arch; PR, petrous
ridge of the temporal bone; DS, dorsum sella; LS, lambdoid
suture; ACP,
anterior clinoid process; FM, foramen magnum; OB, occipital
bone; SP.
styloid process; ALW, anterolateral wall, maxillary antrum; MW, medial
wall, maxillary antrum; Mf, mental foramen, NS, nasal septum; SMF,
sphenomaxillary fissure; SR, supraorbital ridge of the orbit; MP, mastoid
process; MB, mandibular body; SS, sphenoid sinus,

## **SUBMENTOVERTEX PROJECTION**

- \*The submentovertex projection (also called the base or full axial projection)
- It is used to demonstrate the base of the skull, the position and orientation of the condyles, the sphenoid sinus, the curvature of the mandible, the lateral wall of the maxillary sinuses
- \*and any displacement of a fractured zygomatic arch.





Representative image obtained from the SMV projection. EAC, ethmoidal air cells; NS, nasal septum; PP, pterygoid process; fO, foramen ovale; fR, foramen rotundum; fS, foramen spinosum; CN, condylar neck; CH, condylar head; FM, foramen magnum; ZA, zygomatic arch; Z, zygoma; ST, sella turcica; PCP, posterior clinoid process; SS, sphenoid sinus; EWO, lateral wall of the orbit; PWM, posterior wall of the maxillary sinus; AWM, anterior wall of middle cranial fossa, AWS, anterior wall of maxillary sinus. Mandibular Oblique Lateral Projection Two oblique lateral projections commonly are used to examine the mandible, one for the body and one for the ramus.

### **• MANDIBULAR BODY PROJECTION**

• The mandibular body projection **demonstrates the premolar-molar region and the inferior border of the mandible.** 

 It provides much broader coverage than is possible with periapical projections



## MANDIBULAR RAMUS PROJECTION

- The mandibular ramus projection gives a view of the ramus from the angle of the mandible to the condyl.
- It often is very useful for examining the third molar regions of the maxilla and mandible



## **TemproMandibulat-joint-projections**

•TMJ tomography help in visualization of the condyle, articulator eminence and glenoid fossa.

• It can be also used to determine the joint space and to evaluate the extent of movement of condyle when the mouth is open

- 1-Transcranial-view: It used in visualization the superior surface of the condyle and the articulator eminence, the joint space also seen
- 2-Transorbital view: It demonstrate the entire latero-medial articulating surface of the body, the condyle and articulator eminence and the condylar neck.
- **3-Transpharyngeal view**: It also called infra cranial view, it demonstrate the angular process from the mid mandibular ramus of the condyle. This tech. helps in diagnosis of fracture of the condyle of and condylar neck and in detection alteration in condyle morpholog

## Thank you for your kind attention



#### Radiology

Patient management and radiography of patients with special needs Lecture II

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The Radiographic examination techniques must often be modified to reach the specific diagnosis and to overcome the main difficulties that involve:



#### □ Mandibular third molars

- □ Endodontic
- □ Edentulous alveolar ridge
  - Children
  - Gagging reflex
  - اعاقات. Patients with disabilities

1. Mandibular third molars The difficulty is the placement of the film posteriorly to record the entire mandibular third molar, (the solution is by using surgical needle holder to hold and position the film in the mouth).

## 2. problems encountered during endodontic The main difficulties involve:

\*Film placement and stabilization when endodontic instruments, rubber dam and clamps are in position. The problem of film packet placement and stabilization can be solved by taping the film packet to one end of a wooden tongue spatula. That positioned in the mouth and then held by the patient.

\*Assessing root canal length. (the solution to calculating the actual length of a root canal by using bisecting technique as follow:

a) Measure the radiographic tooth length.

b) Measure the radiographic instrument length.

c) Measure the actual instrument length.d) Use this formula:

Actual tooth length = radiographic tooth length\*actual instrument length /radiographic instrument length

## A. Grossmann Formula

 $\frac{actual \ length \ of \ tooth}{radiographic \ length \ of \ tooth} = \frac{actual \ length \ of \ instrument}{radiographic \ length \ of \ tooth}$ 



\*Identification and separation of root canals.

(the solution is by localization techniques using **Tube shift technique (Clark's rule):**  in this technique the area in question is anesthetized, a small hypodermic needle is inserted in mucobuccal fold, a radiograph is taken, then use another film and second radiograph is taken with mesial shifted tube. The 2 films are processed and compared

If the object or the root canal in the second radiograph appears more mesialy, that means the its located far (lingualy or palately), while if it is more distally (in relation to the needle) it means it is buccally positioned, and if it is not move it means that it is close to the needle. \*note: to remember the tube shift technique.

Keep in your mind the word (SLOB): Same = Lingual, Opposite = Buccal



**3. Edentulous patient** Edentulous patient requires dental radiograph to detect the presence of root tips, impacted teeth and lesions, to establish the exacted position, all the normal anatomic land marks relative to the crest of alveolar ridge should be well known.



**4. Child patient** Children are unlikely to be suggested to x-ray until five to six years old, except in cases of trauma and injury usually for upper anterior teeth. To manage a child patient you should:

- a. Describe the x-ray machine to the child
- b. Show him a radiograph of another child's teeth
  - Use conveniently small intraoral films use Lead apron
  - Exposure factors (mA, kVp, time) must be **reduced.**
  - Extraoral films can be used instead of intraoral.
  - . Radiographic procedures should not be hurried
- h. If the child cannot hold or stabilize the film, ask his parent for assistance.

#### 5. Gagging Reflex

A gag reflex is a protective mechanism of the body that serves to clear the airway from obstruction.

In the dental radiography a hypersensitive gag reflex is a common problem. This makes the film placement in the desired position particularly difficult especially in molar regions there are some important hints to reduce gagging reflex, such as:

- a. Exposure sequencing:by-diverting the patient's concentration away from gagging reflex like asking the patient to breathe deeply through the nose or moving his/her arm.
  - Patient and equipment preparations to limit the time
  - Exposure sequencing: start with anterior teeth, then the premolar and finally molar
  - Film placement and technique: Each film must be placed and exposed as quickly as possible.
- e. Use of extraoral radiograph: In uncontrolled gag reflex
- f. Using topical anesthetic agent

#### 6. Physical Disabilities

- a. Vision impairment: if a patient is blind, using clear verbal explanations and keep the patient informed of what is being done and explain each procedure before performing it.
- b. Hearing impairment: if a person is deaf or hearing impaired, the dental radiographer may ask the caretaker to act as interpreter, or use written instructions.

c. Mobility impairment: if a person is in a wheelchair and does not have use of the lower limbs, assist the patient in transferring to the dental chair. If a transfer is not possible; we perform the procedure with the patient seated in the wheelchair. If a person does not have use the upper limbs and a holder cannot to stabilize the film placement, ask the caretaker to assist with film holding.

#### 7. Developmental Disabilities

It includes (Autism, cerebral palsy, epilepsy and other neuropathies and mental retardation). A person with a developmental disability may have problems with coordination or comprehension of instruction. If coordination is a problem, mild sedation may be useful.

is a الفهمIf comprehension problem and the patient cannot hold a film, the caretaker may be asked to assist with film holding. In some cases, no intraoral films must be used and change to extraoral films.

#### 8.Neuromuscular problems Refer to patient inability to remain immobile





- **a. Speed** is essential in radiographic procedure.
- b. Minimization the exposure interval by using **fast films** 
  - . Using of films holders that can be stabilized by **another person**
- d. Extraoral films may be useful.
- e. Sedation sometimes is essential.
- f. Radiograph can be performed under anesthesia



## Thank you for your kind attention



#### RADIOGRAPHIC APPEARANCE OF COMMON DENTAL DISEASES

Lecture 12

3<sup>rd</sup> level

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## RADIOGRAPHIC APPEARANCE OF COMMON DENTAL DISEASES

- 1-Dental caries
- ° 2-Periodontal Diseases
- ° 3-pericoronitis
- 4-Inflammatory lesions of the jaws:
- 5-Fructures
- o 6- Impacted tooth

## 1-Dental caries

•Dental caries is the common infectious disease strongly influenced by diet, affecting 95% of population. Radiography is useful for detecting dental caries because the carious process causes tooth demineralization. The carious lesion (the demineralized area of the tooth that allows greater infiltration of x-rays) is darker (more radiolucent) than the unaffected portion and may be detected on radiographs

## 1-Dental caries

- An early carious lesion may not have yet caused sufficient demineralization to be detected radiographically.
- Intraoral radiography can reveal carious lesions that otherwise might go undetected during a thorough clinical examination.
- A number of studies have shown the value of dental radiographs by repeatedly demonstrating that approximately half of all proximal surface lesions cannot be seen clinically and may be detected only with radiographs

## Interpretation of Dental Caries (DC) regarding to its location

- Interpretation of Incipient الله Occlusal DC :Radiographs are usually not effective for the detection of an occlusal carious lesion until it reaches the dentin.
- Interpretation of Moderate Occlusal DC : The moderate occlusal lesion is usually the first to induce specific radiographic changes.
- The classic radiographic change is a broad-based, thin radiolucent zone in the dentin with little or no changes apparent in the enamel.

# Interpretation of Dental Caries (DC) regarding to its location



## **PROXIMAL CARIES**

Radiographic detection of carious lesions on the proximal surfaces of teeth depends on loss of enough mineral to result in a detectable change in radiographic density.
Approximately 40% demineralization is required for radiographic detection of a lesion

## PROXIMAL CARIES


#### Facial, buccal, and lingual caries

•Facial, buccal, and lingual carious lesions occur in enamel pits and fissures of teeth. When small, these lesions are usually round, as they enlarge, they become elliptic or semilunar. They demonstrate sharp, well-defined borders. It is difficult to differentiate between buccal and lingual caries on a radiograph.



#### ROOT SURFACE CARIES Root surface

Root surface caries (also called cemental caries) involves both cementum and dentin. Its prevalence is approximately40% to 70% in an aged population. The tooth surfaces most frequently affected are.. in order, buccal, lingual, and proximal.



#### **RECURRENT CARIES**

 Recurrent caries is that occurring immediately next to a restoration. It may result from poor adaptation of a restoration, which allows for marginal leakage, or from inadequate extension of a restoration. In addition, caries may remain if the original lesion is not completely evacuated, which later may appear as residual or recurrent caries. **The radiographic appearance** of recurrent caries depends on the amount of decalcification present and whether a restoration is obscuring the lesion



#### 2-Periodontal Diseases

- The most common of periodontal disease are gingivitis and periodontitis. Assessment of Periodontal Disease, contributions of radiographs
- Radiographs play an integral role in the assessment of periodontal disease. They provide unique information about the status of the periodontium and a permanent record of the condition of the bone throughout the course of the disease.

#### 2-Periodontal Diseases

• It is important to emphasize that the clinical and radiographic examinations are complementary. The clinical examination should include periodontal probing, a gingival index, mobility charting, and an evaluation of the amount of attached gingiva. Features that are not well delineated by the radiograph are most apparent clinically, and those that the radiograph best demonstrates are difficult to identify and evaluate clinically.

#### Radiographic features of healthy periodontium

 A healthy periodontium can be regarded as periodontal tissue exhibiting no evidence of disease. However, to be able to interpret radiographs successfully clinicians need to know the usual radiographic features of healthy tissues where there has been no bone loss.

# Radiographic features of healthy periodontium

• The only reliable radiographic feature is the **relationship between the crestal bone margin and the cementoenamel junction (CEJ).** 

• If this distance is within **normal limits (2-3 mm)** and there are **no clinical signs of loss of attachment**., then it can be said that there has been **no periodontitis** 



## Radiographic features of periodontal disease

- Acute and chronic gingivitis
- Radiographs provide no direct evidence of the soft tissue involvement in gingivitis. Periodontitis

#### • Periodontitis

 is the name given to periodontal disease when the superficial inflammation in the gingival tissues extends into the underlying alveolar bone and there has been loss of attachment.

#### Radiographic features of periodontal disease

• The destruction ندمير of the bone can be either localized affecting a few areas of the mouth, or generalized affecting all areas.

• The radiographic features of the different forms of periodontitis **are similar**; it is the distribution and the rate of bone destruction that varies.

## The terms used to describe the various appearances of bone destruction include:

- Horizontal bone loss
- Vertical bone loss
- Furcation involvements.

• The terms horizontal and vertical have been used **traditionally** to describe the direction or pattern of bone loss using the line joining two adjacent teeth at their cemento-enamel junctions as a line of reference. The amount of bone loss is then assessed **as mild, moderate or severe.** 

Severe vertical bone loss, **extending from the alveolar crest and involving the tooth apex** 





• The **term furcation** involvement describes the radiographic appearance of bone loss in the furcation area of the roots which is evidence of advanced disease in this zone. Although central furcation involvements are seen more readily **in mandibular molars**, they can also be seen in **maxillary molars l** 



## **3-PERICORONITIS**

- The most common radiographic feature of pericoronitis of mandibular third molar is that there is **presence of distal bone loss.**
- This distal bone loss is semilunar or circumferential in shape.
- In the case of mesially tilted impaction, bone loss is present on the mesial side.



## 4-Inflammatory lesions of the jaws

- inflammatory lesions are by far the most common pathologic condition of the jaws. When the initial source of inflammation is a necrotic pulp and the bony lesion is restricted to the region of the tooth, the condition is called a periapical inflammatory lesion. When the infection spreads in the bone marrow and is no longer contained, it is called OSteomyelitis.
- It must be emphasized that the names of the various inflammatory lesions tend to describe their **clinical and radiologic presentations and behavior**;

### Normal radiographic appearances

• The appearances of normal, healthy, periapical tissues vary from one patient to another, from one area of the mouth to another and at different stages in the development of the dentition.



#### Radiographic Features of periapical lesion

• The radiographic features of periapical inflammatory lesions vary **depending on the time course of the lesion** 

 A-Early lesion Early periapical inflammatory lesions may show no radiographic change in the normal bone pattern. The earliest detectable change is loss of bone density, which usually results in widening of the periodontal ligament space at the apex of the tooth and later involves a larger diameter of surrounding bone. At this early stage no evidence may be seen of a sclerotic bone reaction.



#### **B-Periapical granuloma**

Periapical granuloma are the most common periapical radiolucencies encountered in dental practice .
Radiographicly the lesion is not fully dark but it has greyish appearance with well defined borders , there is a loss of lamina dura in relation with the affected tooth , the size of radiolucency is less than 1.5 cm in diameter if the size larger so it consider periapical cyst



1. Granuloma Periapical Radiograph Image

#### **C-Chronic periapical abscess**

Radiographic appearance of the lesion may be quite variable متغير, the lesion may have radiolucent appearance with illdefined borders and **in this time it impossible to differentiate from granuloma or cyst** 



#### D-Condencing ostitis Lesion is localized and present as **increased band of radioopacity associated with root of the tooth**



## **5-FRUCTURES:**

- Radiographic signs of fractures The following are general signs that may indicate the presence of a fracture of bone or tooth:
- 1. The presence of a **radiolucent line** (usually sharply defined)
- 2. A change in the normal anatomic outline or shape of the structure.
- 3. A defect in the outer cortical boundary, which may appear as a deviation in the smooth outline.
- 4. An increase in the density of the bone, which may be caused by the overlapping of two fragments of bone





## 6- Impacted tooth

 Accurate diagnostic imaging is an essential requirement to derive the correct diagnosis and optimal treatment plan, as well as monitor and document the treatment progress and final outcome. Intra oral periapical occlusal and panoramic films can provide this









## Thank you for your kind attention



#### **TEMPROMANDIBULAR JOINT IMAGING**

Lecture 13

3<sup>rd</sup> level

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# TMJ is the area where the mandible articulates with cranium

- Each joint is formed by the articulating components of the mandible and the temporal bone.
- TMJ is consists of :
- □ bones : mandibular condyle and temporal bone
- $\circ$   $\Box$  Articular disc
- 🗆 Capsular ligament
- ∘ □ Joint cavity (synovial membrane)


## 1- Bony components:

- The mandibular condyle is the mandibular component of the TMJ. Various shapes noticed; may be flat, round, or markedly convex.
- The articular component of the temporal bone is formed by the inferior surface of the squamous process, and is composed of the glenoid or mandibular fossa posteriorly and the articular eminence and tubercle anteriorly. Glenoid fossa depths vary. Young infants lack a definitive fossa and articular eminence. The fossa and articular eminence develop during the first 3 years of life and reach a mature shape by age 4 years, although the cortices may remain indistinct until adulthood

## 2- Articular disc:

- Also referred to as a meniscus is composed of avascular fibrous connective tissue, and is positioned between the condylar and temporal components of the joint.
- The disc divides the joint cavity into two compartments;
- the inferior and superior joint spaces, which are located below and above the disc, respectively.
- Normal disc has
- $\circ \square$  a biconcave shape
- □ a thick anterior band, a thicker posterior band, and a thin middle or intermediate zone.
- $\circ$   $\Box$  Thicker medially than laterally



## 3-Retrodiscal Tissues (Posterior Disc Attachment) :

 The retrodiscal tissues consist of superior and inferior lamellae enclosing a region of loose vascular tissue, and this is often referred to as the bilaminar zone. تنائية الصفائح



## Diagnostic imaging of TMJ

- The type of imaging technique selected depends on the followings:
- •1. specific **clinical problem**, whether imaging of hard or soft tissues is desired
- •2. the **amount of diagnostic information** available from a particular imaging modality
- $\circ$  3. the cost of the examination
- 4. The radiation dose. Both joints should be imaged during the examination, for comp

## Types of imaging techniques For osseous structures

- ° 1. Panoramic radiography (OPG
- 2. Cone beam computed tomography (CBCT)
- 3. Multidetector computed tomography (MDCT)

• for soft tissue imaging the best choice is MRI magnetic resonance imaging

## Abnormalities of the TMJ

- 1- Developmental Abnormalities such as (condylar hypoplasia ,condylar hyperplasia and coronoid hyperplasia)
- 2- Soft tissue abnormalities such as disc displacement (with or without reduction)
- ° 3- Trauma such as fracture and effusion
- °4-Ankylosis such as bony and soft tissue ankylosis
- ° 5- Tumors (benign and malignant )

## Condylar hyperplasia:

- **Condylar hyperplasia:** Developmental abnormalities result of disturbances in the normal growth and development
- Clinically: there are (condylar enlargement, mandibular asymmetry, chin may be deviated to the unaffected side)
- Radiographically: the condyle appears enlarged and more radiopaque

## Condylar hypoplasia

- **Condylar hypoplasia** is an undersized mandibular condyle, which may be the result of congenital, developmental, or acquired diseases that affect condylar growth.
- Clinically: Unilateral mandibular hypoplasia and facial asymmetry. Deviation of the mandibular midline to the affected side
- **Radiographically**: the condyle may be diminished in size with thin

## Disc Displacement

- It may be displaced anteromedially, medially, or anterolaterally. Lateral and posterior displacements are extremely rare.
- A disc is considered anteriorly displaced when its posterior band is located anterior to the normal position and the thin intermediate zone is no longer positioned between the condyle and articular eminence





## Disc Displacement

The articular disc cannot be visualized with conventional imaging, CBCT, or MDCT; so **MRI** is the technique of choice. □ Anteromedial displacement is indicated in corrected sagittal images □ Medial or lateral displacement is indicated on corrected coronal MRI when the body of the disc is positioned at the medial or lateral aspect of the condyle, respectively





## **Rheumatoid Arthritis**

- RA is a heterogeneous غير متجانس group of systemic disorders that manifests mainly تظهر بشكل رئيسي as synovial membrane inflammation in several joints. The TMJ becomes involved in approximately half of affected patients.
- Clinically:
- $\circ$  1. More common in females
- 2. Occur at any age (increases in incidence with increasing age).
- 3. Usually the small joints of the hands, wrists, knees, and feet are affected in a bilateral, symmetric fashion.
- 4. TMJ involvement is variable; when the TMJ is affected; involvement is often bilateral and often occurs later than in other joints.
- 5. Patients with TMJ involvement complain of swelling, pain, tenderness, stiffness on opening, limited range of motion, and crepitus.

## Radiographically:

- Radiographically:
- 1- CT imaging allows detailed assessment of the osseous changes associated with RA.
- 2- MRI may demonstrate joint effusions, marrow edema, and disc abnormalities.
- 3- Erosion of condylar head progress giving the appearance of sharpened pencil

## Trauma

#### • Trauma

• **Effusion**انصباب المفصل الفكيIt is an influx of fluid into the joint and may be associated with trauma, soft tissue abnormalities, such as **disc displacement, or arthritic conditions**.

#### • Clinically:

- 1. swelling over the affected joint
- $\circ$  2. pain in the TMJ preauricular region or ear
- 3. Limited range of motion.
- 4. Patients may complain of the sensation of fluid in the ear, tinnitus طنين في الاذن, hearing difficulties, and difficulty occluding السداد the posterior teeth.
- Radiographically: Joint effusions are best seen on T2- weighted MRI as high signal (white) areas around the condyle. The involved joint spaces would be increased in width

## **Fractures**

- Condylar neck fractures are most common and are often accompanied by dislocation of the condylar head.
- Condylar head fractures may be horizontal, vertical, or compression fractures.
   Unilateral fractures, which are *more common* than bilateral fractures, may be accompanied by a mandibular body fracture on the contralateral side

## Fractures

#### • Clinically:

- 1. Swelling over the TMJ
- ° 2. Pain

0

- 3. Limited range of motion
- 4. Deviation to the affected side
- $\circ$  5. Malocclusion or anterior open bite.

## Fractures

#### • Radiographically:

- • CBCT is the **preferred** imaging modality to evaluate condylar fractures because there is no superimposition of adjacent structures
- • Condylar neck fractures appear as a radiolucent line.
- Sometimes bone fragments overlap, an area of apparent increased radiopacity may be seen (the "overlapping fragment sign") instead of the radiolucent line

## Neoplasia

- Benign and malignant neoplasms originating in or involving the TMJ are rare.
- **Benign neoplasm**: The most common benign intrinsic tumors involving the TMJ are
- $\circ \square$  Osteochondromas
- $\circ \square$  Osteomas
- $\circ \Box$  osteoblastomas
- $\circ \Box$  Chondroblastomas
- Benign neoplasms and cysts of the mandible (e.g., ameloblastomas, odontogenic keratocysts, and simple bone cysts) may involve the entire ramus, and in rare cases, may extend into the condyle.

#### Malignant neoplasm:

- Malignant neoplasm: Malignant neoplasms involving the TMJs may be primary or, more commonly, metastatic.
- **Primary intrinsic malignant neoplasms** of the condyle are extremely rare and include (Chondrosarcoma, Osteosarcoma, synovial sarcoma, fibrosarcoma of the joint capsule).
- **Extrinsic malignant neoplasms** represent direct extension of adjacent parotid salivary gland malignancies, or other regional carcinomas from the skin, ear, and nasopharynx.

**Clinically:** Malignant neoplasms, whether primary or metastatic, may be asymptomatic, or patients may have symptoms of TMJ dysfunction, such as pain, limited mandibular opening, mandibular deviation, and swelling

#### • Radiographically:

- Benign neoplasia: irregularly shaped enlargement of the condylar head. There may be decreased trabecular bone density (bony destruction) or increased density owing to new, abnormal bone formed by the neoplasm. An osteoma or osteochondroma will have the appearance of being attached to, or growing from, the condyle.
- Malignant neoplasia: CT imaging is the imaging modality of choice to view bone involvement, and MRI is useful for displaying the extent of involvement into the surrounding soft tissues.

#### **Radiographically:**

 Malignant primary and metastatic neoplasms involving the TMJ manifest with a variable degree of bone destruction with ill-defined, noncorticated and irregular borders. Most lack the ability to stimulate new bone formation, with the exception of osteosarcoma and chondrosarcoma, which may display a radiopaque component. Chondrosarcoma appear as an indistinct, radiolucent destructive lesion of the condyle, depending on the ability of the malignant cells to produce a mineralized matrix.

## Thank you for your kind attention



## Radiology

Magnetic resonance imaging(MRI)lecture 143rd level

By: Dr. Yusra H. Al mukhtar

Department of oral and maxillofacial surgery

#### Magnetic resonance imaging (MRI)

MRI is an imaging modality that totally replaces conventional X-ray generating equipment and film by magnetic field.

Essentially it involves the behavior of protons (**positively charged nuclear particles** ) in the simplest atom which is hydrogen that consisting of one proton in the nucleus so it used to create the MRI image.



## **Mechanism of MRI**

To make an MR image, the patient is first placed inside a large magnet. This magnetic field causes the nuclei of many atoms in the body especially hydrogen, to align with the magnetic field.

Then RF (radio frequency تردد لاسلكي) pulse has been emitted تم انبعاثها, causing some hydrogen nuclei to absorb energy and resonate صدى .

## **Mechanism of MRI**

When the RF pulse is turned off, the stored energy is released from the body and the signals detected by coils in the scanner. The magnetic field in MRI scanner is provided by external powerful permanent magnet with strength range from (0.1-4 Tesla), the 1.5 Tesla is the most commonly used and it's about 30000 times the strength of the earth's magnetic field

## **Magnetic Resonance Signal**

The MR signal received by a coil after RF pulse turning **off**, **the magnitude of this signal is** proportional to the overall concentration of hydrogen nuclei in يتناسب حجم هذه الاشارة مع التركيز الكلي لنواق الهيدروجين. the tissue The strength of the signal also **depends** on the degree to which hydrogen is تعتمد قوة الاشارة ايضا على bound within a molecule درجة ارتباط الهيدروجين داخل الجزئ. Tightly bound hydrogen atoms as those present in bone, don't align لاتتوافق مع المجال المغناطيسي الخارجي themselves with the external magnetic field and produce only weak signal. While loosely bound or mobile hydrogen atoms as those present in soft tissues and liquids, react to the **RF pulse and produce a detectible** strong signal

The higher concentration of loosely bound hydrogen atoms, the stronger magnetization, the more intense recovered signal, and the brighter corresponding part of MR image.



Fig 1: randomly oriented atoms



Fig 2: atoms with applied magnetic field

# T1 and T2 relaxation time and image: -

T1 relaxation time represents the time required for 63% of the net magnetization to return to equilibrium نهرين, so it reflects the ability of hydrogen atoms to transfer their excess energy to surrounding molecules.

- **T2 relaxation time** is the time constant that describe the exponential rate of loss of transverse يصف المعدل الإساسي لفقدان المغنطة magnetization.

#### **T1- Weighted image:**

#### **T2-**Weighted image

**T1- Weighted image:** are most commonly used to demonstrate anatomy of the part being imaged depending on the differences in T1 values of tissues. Tissues with short T1 times, such as fat, appear bright. While tissue with long T1 times, such as CSF (water or fluid), appear dark.



Fig. 4 A sagittal MRI scan of the head and neck (TI weighted, so CSF appears black). Bone does not give a signal and therefore appears dark, while bone marrow gives a strong signal and appears white. B An axial MRI scan, at the level of the orbits and ethmoidal air sinuses. **T2- Weighted image**: are most commonly used for identifying **pathology** because pathological tissue usually contains more water than surrounding tissues due to inflammation, depending on the differences in T2 values of tissues.

Tissues with long T2 times, such as CSF or TMJ fluid, appear bright. While tissue with short T2 times, such as fat, appear dark



FIG. 3 A, T1 -weighted MR image of the TMJ. B, T2-weighted MR image C, the disk is anteriorly displaced (arrow), with the posterior band in the 9 o'clock position relative

#### Main indications for MRI in the head and neck

 Image: The salivary glands

- $\hfill\square$  The tongue and floor of mouth
- □ The pharynx
- □ The larynx
- □ The sinuses
- □ The orbits
- Investigation of the TMJ to show both the bony and soft tissue components of the joint including the disc position

 $\Box$  evaluation of the site, size and extent of all soft tissue tumors

Advantages

### **Disadvantages**

## **Advantages**

- Ionizing radiation is not used
- No adverse effects have yet been demonstrated
- Image manipulation available
- High-resolution images can be reconstructed in all planes (using 3D volume techniques).

• Excellent differentiation between different soft tissues is possible and

between normal and abnormal tissues enabling useful differentiation between benign and malignant disease

and between recurrence and postoperative effects

• Useful in determining intramedullary spread.

## Disadvantages

- Bone does not give an MR signal, a signal is only obtainable from bone marrow, although this is of less importance now that radiologists are used to looking at MR images
- Scanning time can be long and is thus demanding on the patient
- It is contraindicated in patients with certain types of surgical clips, cardiac pacemakers, cochlear implants and in the first trimester of pregnancy
- Equipment tends to be claustrophobic and noisy

## Disadvantages

- Metallic objects, e.g. endotracheal tubes need to be replaced by nonferromagnetic alternatives
   Equipment is very expensive
- The very powerful magnets can pose problems with siting of equipment although magnet Shielding is now becoming more sophisticated
- Facilities are not widely available, but with the development of small open systems suitable for district general hospitals this is gradually
  - changing
- Bone, teeth, air and metallic objects all appear black, making differentiation difficult





FIG. 3 A, T1 -weighted MR image of the TMJ.. B, T2-weighted MR image C, the disk is anteriorly displaced (arrow), with the posterior band in the 9 o'clock position relative



Fig. 4 A sagittal MRI scan of the head and neck (TI weighted, so CSF appears black). Bone does not give a signal and therefore appears dark, while bone marrow gives a strong signal and appears white. B An axial MRI scan, at the level of the orbits and ethmoidal air sinuses.

# Thank you for your kind attention



Presentation title

## **DIGITAL IMAGING**

Lecture 153rd level

**By:** Dr. Yusra H. Al mukhtar

**Department of oral and maxillofacial surgery** 

## **Digital Imaging**

 Digital imaging produces a dynamic image in which the visual الخصائص characteristics of density and contrast can be manipulated to meet specific diagnosis or to correct errors in exposure techniques.
# Main Components of Digital Imaging System

- • The x-ray source
- The detector الكاشف: it measures the photon intensity of the x-ray beam and convert it into electrical signal (analog signal)
- Analog-digital converter المحول الرقمي (ADC) or digitizer المحول الرقمي: is used to change the analog signal to a numeric representation based on the binary number system recognizable by the computer.
- Image display عرض المصور: which are conventional computer monitors, thin film transistor used in laptop or flat panel computer displays, hard copies (like film printer or paper printer

### Methods of Acquiring a Digital Image

• Digital images are acquired either:

- • **Directly** \_ using a sensor or imaging plate replacing conventional film.
- • Indirectly \_ by scanning and digitizing a film-captured image.

Direct digital imaging systems are divided into two types:

- 1- Real time or corded السلكي: This system use conventional عادي x-ray machine but conventional film is replaced by either a CCD (charge coupled device رجهاز مقترن بالشحن) or a CMOS (complementary metal oxide semiconductor (موصل اكسيد معدني مكمل sensor which is connected to the computer via a cable (or cord).
- The X-ray photons that reach the sensor are converted to light, and picked picked by the CCD/CMOS and converted into an electrical charge which, once produces a digital image on the monitor of the computer (so called real time).
- Specially designed intraoral sensor holders similar to those used for conventional film, have been developed, when used clinically, the sensors need to be covered with a protective plastic barrier envelope for infection control purposes



### 2- Photostimulable phosphor storage plate or cordless

- In This system the conventional film is replaced by photostimulable phosphor imaging plates (PSPP)
- ° phosphor layer absorbs and stores the X-ray energy.
- The image plate is then placed in a reader where it is scanned by a laser beam. The stored X-ray energy in the phosphor layer is released as light,
- the information is displayed as a digital image on the monitor
- $\circ$  The time taken to read the plate depends on the system being used, and the size of the plate, but usually varies (1 5) minutes.
- The intraoral plates are inserted into protective barrier envelopes and can then be used in conventional film holders



# Theory

- As computers deal with numbers and not pictures, a radiographic image within a computer is represented as a sequence of numbers. This image may be considered as a grid or matrix of tiny boxes or pixels. Each pixel has an x and y axis. Each number, and hence each pixel has an appropriate shade of grey.
- The range of numbers is normally from (0 256) with **0 representing black**, **256 representing** white and all others are shades of grey.
- The pictures can be changed by giving the pixels different numbers. The coordinates of pixels may be changed also, and the shades of grey may be altered or using different colures. These variables are the basis for what is called (image processing or image manipulation).
- Despite being able to alter the final image, the computer cannot provide any additional real information to the original image. It should be remembered that although enhancement may make images look aesthetically more pleasing, it may also cause clinical information to be lost and diagnoses compromised.

## Advantages of Digital Imaging over Conventional Film-Based Radiography:

- 1- Lower dose of radiation required as both types of digital image receptors are **much more efficient at recording photon energy** than conventional films.
- 2- No need for conventional processing film faults and the hazards associated with handling the chemical solutions.
- 3- Easy storage and archiving of patient information
- 4- Easy transfer of images electronically (teleradiology).
- 5- Image enhancement and processing which include: (Inversion (reversal), Alteration in contrast, embossing or pseudo 3-D, Magnification, Automated measurement, image subtraction)



# **Digital image subtraction**

• When **two images of the same object** are registered and the image intensities of corresponding pixels are subtracted, **a new difference image is produced.** This is useful in the diagnosis of (periodontal diseases, carious lesions, evaluation of small changes in the condylar position and assessment of dental implant).

## Disadvantages of Digital Imaging

- 1- Expensive, especially panoramic systems
- 2- Long-term storage of the images although this should be solved by saving them on CD-ROM
- 3- Digital image security and the need to back up data
- 4- The connecting cable (or cord) can make intraoral placement of these system's sensor difficult.
- 5- Loss of image quality and resolution on the hard copy-out when using thermal, laser or ink-jet printers
- 6- Image manipulation can be time-consuming and misleading to the inexperienced
- 7- While manufacturers provide safeguards to any tampering with original images within their own software, it is relatively easy to access these images using cheap software and to change them





### Computed tomography (CT)

CT scanners use X-rays to produce sectional or slice images, as in conventional tomography, but the radiographic film is replaced by very sensitive crystal or gas detectors. The detectors measure the intensity of the X-ray beam emerging from the patient and convert this into digital data which are stored and can be manipulated by a computer. This numerical information is converted into a grey scale representing different tissue densities, thus allowing a visual

image to be generated

#### Dental Cone Beam CT

Dental cone beam <u>computed tomography</u> (CT) is a special type of x-ray machine used in situations where regular dental or facial x-rays are not sufficient. It is <u>not used routinely</u> because the radiation exposure from this scanner is significantly more than regular dental x-rays. This type of CT scanner uses a special type of technology to generate <u>three dimensional (3-D) images of</u> <u>dental structures</u>, and bone in the <u>craniofacial</u> region in a single <u>scan</u>. Images obtained with cone beam CT allow for more precise treatment planning.





Cone beam CT is not the same as conventional CT. However, dental cone beam CT can be used to produce images that are similar to those produced by conventional CT imaging. CBCT, anew imaging modality introduce **three-dimensional** image beside to three multiplaners views, coronal, sagittal and axial in one rotation only with low dose and simpler technique than multi detector computed tomography( MDCT), it is a proved that the accuracy of CBCT in diagnosis was compared or higher than multi-slice CT, because it has isotropic voxel with high resolution and small voxel less than 0.3 mm, and it could produce 160 to 360 slice with high resolution compared with MDCT



With cone beam CT, an x-ray beam in the shape of a cone is moved around the patient to produce a large number of images, also called views. CT scans and cone beam CT both produce high-quality images. Dental cone beam CT was developed as a means of producing similar types of images but with a much smaller and less expensive machine that could be placed in an **common uses of CBCT**  Dental cone beam CT is commonly used for: treatment planning of <u>orthodontic</u> issues. surgical planning for <u>impacted</u> teeth. diagnosing <u>temporomandibular joint disorder</u> (TMJ). accurate placement of dental <u>implants</u>. evaluation of the jaw, <u>sinuses</u>, nerve canals and <u>nasal</u> <u>cavity</u>.

detecting, measuring and treating jaw <u>tumors</u>. determining bone structure and tooth orientation. locating the origin of pain or <u>pathology</u>. <u>cephalometric</u> analysis.

reconstructive surgery.outpatient office.

#### **Preperation for CBCT IMAGING**

A cone beam CT examination requires no special preparation.

Prior to the examination, you may be asked to remove anything that may interfere with the imaging, including metal objects, such as jewelry, eyeglasses, hairpins and hearing aids.

### **Advantages of CBCT**

- -The focused x-ray beam reduces scatter radiation, resulting in better image quality.
- -A single scan produces a wide variety of views and angles that can be manipulated to provide a more complete evaluation.
- -Cone beam CBCT scans provide more information than conventional dental x-ray, allowing for more precise treatment planning.
- -CBCT scanning is painless, noninvasive and accurate.
- -No radiation remains in a patient's body after a CBCT examination. *Limitations of CBCT*
- Although it is less radiation dose than computed tomography, but it still higher than conventional x-ray
- Metallic objects, such as fillings may produce marked streak on the

image

# THANK YOU



### **CONTRAST MEDIA USED IN RADIOGRAPHY**

Lecture 17

3<sup>rd</sup> level

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# **Contrast Media Used In Radiography**

• Contrast media: is a radiopaque substance which is introduced into human body to examine certain structures not seen well by conventional means. It is also used to see vascularity of certain lesions, boundaries, or pathology.

### Types of Contrast Media According to Imaging Modality:

- 1- Radio-Contrast Media (ex. Barium, Iodine)
- 2- MRI Contrast Media (ex. gadolinium, iron oxide)
- Oracle of the second contrast Media (micro gas bubbles smaller than a red blood cell)

# Ideal Contrast Material

- The ideal contrast material should have the following **properties:**
- $\circ$   $\bullet$  Non-toxic
- $\circ \bullet Radiopaque$
- •Minimum side effects
- • Less viscosity
- • Low surface tension
- $\circ$   $\bullet$  Should not cross blood-brain barrier
- • Similar physiologic properties when compared to blood and saliva.

### **Clinical Application of Contrast Media**

- 1- Sialography The sialography is a radiographic demonstration of major salivary glands by introducing a radio opaque contrast medium into the ductal system of sub-mandibular and parotid glands to reach a definitive diagnosis when there is Stones, obstriction, Masses or Tumors, and Recurrent Pain & Swelling.
- There are some limitations for using sialography contras media:
- • History of contrast media **allergies**
- • Severe inflammation of the salivary ducts
- When clinical examination or routine radiographs have shown a calculus close to the duct opening, as injection of the contrast medium may **push the calculus back** down the main duct where it may be **inaccessible**





#### 2- Temporomandibular joint arthrography

This technique used to obtain diagnostic information about joint space, surrounding soft tissue, and cartilage, in case of pain, clicking, disk Subluxation, Ankylosis, and Arthritis using **Non-ionic iodinated contrast medium that injected carefully into the lower joint space**.



Arthrograph of a normal tmj with closed mouth. the needle (white arrow) and the contrast medium outlining the lower joint space (open black arrows)

# **Clinical Application of Contrast Media**

#### • 3- Angiography

• This involves the introduction of aqueous iodine-based contrast media into **selected blood vessels**. **In the head and neck region**, this involves usually the carotids (common, internal or external) or the vertebral arteries to show the vascular anatomy

### • 4- Lymphography

• This involves injection of contrast agents into **lymphatics system** including lymph nodes, lymph ducts, lymphatic tissues, and lymph vessels.

### **Clinical Application of Contrast Media**

#### • 5- Computed Tomography

 The computed tomographic images can be enhanced by the use of contrast media providing additional information and to obtain a differential change between normal & pathological tissues. Contrast agents can be administered i.v. (intravenously) or orally



#### 6- Ultrasound Imaging

Contrast agents **can improve the image quality** in sonography either by decreasing the reflection of the undesired interfaces or by increasing the back reflection from the desired regions.

- 7- Magnetic Resonance Imaging
- MRI contrast agents alters the magnetic properties of nearby water molecules, which enhances the quality of MR images, the main contras media that used with MRI is **gadolinium.**



### Adverse Reactions of Contras Media

- - Mild: nausea, vomiting, cough, sneezing, headache, dizziness, shaking, altered taste, itching, sweats, rash, swelling (eyes, face).
- Moderate: tachycardia / bradycardia, hypertension / hypotension, bronchospasm.
- -Severe: laryngeal edema, convulsions, cardiopulmonary arrest.

First-line Emergency Drugs and Instruments That Should be in The Room Where Contrast Medium is Injected

- • Oxygen
- • Adrenaline 1:1000
- • Antihistamine
- • Atropine
- $\circ~$   $\bullet$  Beta 2 agonist inhaler
- • Intravenous fluids (normal saline or ringer's solution)
- • Anti convulsive drugs (diazepam)
- • Sphygmomanometer(BP)
# Thank you for your kind attention



## SALIVARY GLAND IMAGING

Lecture 18 3<sup>rd</sup> level

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## • ANATOMY AND OUTLINE OF IMAGING

- The parotid, submandibular and sublingual glands are regarded as **major salivary glands** and have bilaterally symmetric lobes.
- **The parotid gland** (the largest salivary gland) is situated at the parotid space. The gland is divided into **deep** and **superficial lobes** by *branches of the facial nerve*.
- The duct of salivary secretion is known as **Stensen duct** that runs anteriorly on the superficial portion of the masseter muscle and pierces the buccinator muscle.

- The submandibular gland is located mainly in the so-called mandibular triang.
- The secretory duct is known as **Wharton duct** that runs on the surface of the mylohyoid muscle and opens **at the anterior portion of the floor of the mouth**.
- **The sublingual gland** is located under the mucosal surface of the oral cavity and lies on the mylohyoid muscle.
- The gland has many small ducts known as '**ducts Bartholin**' that open directly on the mucosal surface of the floor of the mouth.
- ° Some of these small ducts are fused with Wharton duct.

- Types of Salivary Gland Imaging
- Conventional imaging:
- ° This includes occlusal, panoramic or posteroanterior (PA) views.
- **Sialography**: It is defined as a method of radiographic study of the salivary gland and alveoli of the parotid and submandibular salivary glands.
- **Computed tomography**: It demonstrates small differences in soft-tissue radiographic examination and distinction between gland and the adjacent soft tissues is greatly improved.

- MRI: It is useful in discrete swelling of salivary glands and provides excellent soft tissue details.
- It readily enables differentiation between the normal and the abnormal.

• **ULTRASONOGRAPHY (USG):** It involves the transmission of energy into the salivary tissues, receiving of the energy after the tissues have reflected it and recording it so that it can be presented for interpretation.

#### • CONVENTIONAL RADIOGRAPHY

- Mainly views taken in CR are occlusal, panoramic, and lateral oblique view and PA views.
- It is generally limited to detection of sialoliths الحصيات اللعابية, primarily in submandibular gland, Stensen duct and Wharton duct.
- Sialoliths occur more frequently in submandibular gland than in parotid gland.
- They can rarely be seen in sublingual or minor salivary gland.

 On conventional extraoral radiography, such as panoramic tomography and PA radiography, a sialolith of the submandibular gland usually appears as a round, isolated radio-opaque mass beneath the inferior border of the mandible



#### • SIALOGRAPHY

- Sialography is a radiographic procedure for detection and monitoring salivary gland disease.
- It is used to examine the ductal acinar system of major salivary gland by injecting radio-opaque contrast medium into the gland to make it visible on radiographs.
- After injection of contrast agent radiographs are taken on plane film. The lateral oblique is best to delineate submandibular gland because it projects image below the ramus of jaw.
- Occlusal view is taken for sialoliths located in anterior portion of duct. For parotid gland, anteroposterior (AP) and panoramic view can be taken.
- After sialographic view is taken the catheter should be removed from duct orifice. Patient is instructed to chew gum or suck on lemon



## • COMPUTED TOMOGRAPHY

- It is valuable in examining salivary gland, particularly after injection of contrast media, i.e. **CT sialography**.
- CT enables the lesions and changes in surrounding structures to be visualised.

## **° CT View of Normal Salivary Gland**

- Parotid gland: It has increased fat content and is encased in a dense capsule. *Because of this*, parotid gland on CT is consistently more radiolucent than surrounding muscle and is distinctly more radioopaque than adjacent fat.
- Parotid duct is not routinely seen on CT without contrast opacification.



• Submandibular gland: Submandibular gland is more radiopaque than parotid gland but of the same density as that of adjacent muscle.

• Sublingual gland: This appears as relatively lucent رشيقة fatty structures





#### • MAGNETIC RESONANCE IMAGING (MRI)

- MRI, like CT, has several advantages over CR for disease localisation. The difference between MRI and CT is **in tissue differentiation**.
- *Because MRI is superior to CT for the tissue differentiation*, it is more effective for qualitative diagnosis, such as determining whether a tumour is benign or malignant.

### • ULTRASONOGRAPHY

- USG is based on inaudible sound في نطاق in the range of frequency الترددالذي يقارب approximately 20,000 to 10 billion (109) cycles/s. It has different velocities الترددالذي النسجة in tissues that differ in density and elasticity from others.
- Normal Appearance of Parotid Gland :parotid gland appears as a homogeneous hyperechoic area. منطقة مفرطة الصدى متجانسة

• Submandibular Gland: The normal submandibular gland also appears as a homogeneous hyperechoic *area relative to the surrounding muscles*, such as the mylohyoid and digastric muscle Doppler Sonography

• Intraglandular *blood flow can be demonstrated* with Doppler sonography.

# Thank you for your kind attention



## **CYSTS OF THE JAW**

Lecture 19

3<sup>rd</sup> level

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# Cyst

- Cyst is **defined** as a pathologic cavity filled with fluid, and is lined by epithelium.
- It can also be **defined** as fluid- or semi-fluid-filled pathologic cavity lined by epithelium more often occurring in the jawbones than in any other bone.
- It is **thought** to arise from the rests of odontogenic epithelium remaining after tooth formation.

## Cysts classification • Odontogenic

## o inflamatory

- ° Radicular (denal) cyst
- Residual radicular cyst

## • developmental

- Lateral periodontal cyst
- Dentigerous cyst
- Non odontogenic
- Nasopalatine cyst/ Incisive cyst
- Bone cysts
- solitary (simple)

## Odontogenic cysts 1-Inflamatory cysts: \*Radicular cyst

- Radicular cyst is an inflammatory type of odontogenic cyst which develops as common sequelae of pulpal necrosis following caries. It is derived from cystic degeneration and inflammatory proliferation of cell rests of Malassez.
- Clinical Features Radicular cyst is commonly seen in second to fifth decades of life with peak frequency in third decade. Around 60% of jaw cysts are radicular cysts or residual cysts.
- Maxillary anterior region is most commonly affected as it is prone to more frequent trauma.

## Radiographic Features

- Radicular cyst appears as radiolucent area at the apex of tooth with welldemarcated sclerotic متصلب margins unless secondarily infected. The size of radiolucency is 1.5 cm or more in diameter.
- In case of secondary infection margin of cyst can be destroyed. Anatomical structures, such as maxillary antrum, nasal fossa and mandibular canal are frequently involved by teeth

## **Differential Diagnosis**

It includes periapical granuloma (size of granuloma is less than 1.5 cm), periapical scar (history), traumatic bone cyst (not associated with teeth) and periapical cemental dysplasia (tooth is vital).



# \*Residual cyst

 Residual cysts most commonly are the retained periapical cysts from teeth that have been removed. They could also develop in a periapical granuloma that is possibly left after an extraction.

Clinical Features Residual cyst can be found in any of the tooth-bearing area of the maxilla or mandible. Size may range from a few milli metres to several centi metres. Clinically, these cysts are usually found on routine radiographic examination of patients. Usually they are painless unless secondarily infected. They do not show expansion of cortical plates.

## **Radiographic Features**

• There is well-defined **unilocular radiolucency in the periapical area of extracted tooth**. *If the cyst is secondarily infected, the hyperostotic border may be absent*. Cyst may displace mandibular canal and adjacent teeth.

## **• Differential Diagnosis**

 Differential diagnosis includes primordial cyst (missing tooth), kerato cyst (mandibular posterior area), traumatic cyst (not associated with teeth) and ameloblastoma (lesion is larger)



## 2-Developmental cysts: \*Lateral periodontal cyst

 Lateral periodontal cyst or botryoid odontogenic cyst is uncommon type of cyst occurring along the lateral surface of tooth root. It is thought to be arising from rests of dental lamina. It accounts for less than 20% of all epithelial-lined cysts.

• **Clinical Features** It is usually asymptomatic and often discovered during normal radiographic examination. It is usually seen in fifth or sixth decade of life with slight **male** predilection. Eighty percent of the cases are reported in mandibular premolar–canine and lateral incisor areas.

#### **Radiographic Features**

- As the name suggests this cyst appears as a radiolucent area situated laterally at middle third of the affected tooth between the apex and the alveolar crest of tooth. It is oval or round in shape. with the size as small as less than 1 cm in diameter to large lesions seen in botryoid عقودية type. The associated tooth is vital. The borders are sclerotic, well-defined surrounding the radiolucency, which is often missing in case of infected cyst.
- **Differential Diagnosis** Differential diagnosis includes **dentigerous cys**t (associated with unerupted tooth), **primordial cyst** (missing tooth) and **radicular cyst** (teeth are non-vital).



# \*Dentigerous cyst

Dentigerous cyst : is the most common type of developmental odontogenic cyst making about 20% of all epithelium- lined cysts of jaw. Mostly, it encloses the crown of an un erupted or supernumerary tooth. It develops as the fluid accumulates between the layers of reduced enamel epithelium and enamel surface of crown of the tooth. It is also called as follicular cyst or pericoronal cyst.

### **Clinical Features**

- Dentigerous cysts develop around the crown of an impacted or embedded unerupted or supernumerary tooth or in association with odontomas. They are frequently associated with mandibular third molar followed by maxillary canines, maxillary third molar and mandibular second molar. They are seen at 10–30 years of age with male predilection. They are asymptomatic and often discovered only on a routine radiographic examination.
- Clinically, they reveal missing tooth and may appear as painless expansion of involved bone; sometimes, large lesions may cause facial asymmetry. They may get infected, causing pain and swelling

### **Radiographic Features**

- Dentigerous cyst appears as well-defined radiolucency with sclerotic borders seen at the cementoenamel (CE) junction of unerupted tooth. The sclerotic border is absent in case of infected cyst. It may be solitary or multiple. Size of cyst varies from small to large lesion confined in the jawbones.
- The cyst is commonly related to single tooth but may enlarge to envelop the adjacent tooth. The teeth are usually greatly displaced from their original position and are found lying on floor of cavity. In mandible, tooth is seen at inferior border of mandible or ramus while in maxilla, it may get displaced into nasal cavity or antrum

## Radiographically

- Radiographically, dentigerous cyst can be central (cyst enclosing the crown of tooth symmetrically), lateral (cyst arising laterally from one side of crown) and Circumferential (when whole tooth lies within the cystic cavity).
- Maxillary molar and canines may get displaced up to floor of orbit while mandibular third molars can be pushed near condylar and coronoid regions. Resorption of neigh bouring tooth can be seen.
- Cortical expansion of involved jaw also occurs. **Computed tomography** (CT) scan is useful in determining the exact dimension of dentigerous cyst .


## **Differential Diagnosis**

- Differential diagnosis includes primordial cyst (radiograph should be taken from different angle),
- adenomatoid odontogenic tumour (AOT; maxillary anterior region),
- calcifying epithelial odontogenic tumour (CEO evidence of calcification),
- ameloblastic fibroma (multilocular),
- ameloblastoma (multilocular) and
- radicular cyst (carious teeth).

# Non odontogenic cyst • \*NASOPALATINE DUCT CYST

- Nasopalatine cyst is also called incisive canal cyst. It is developmental in origin, derived from epithelial-lined vestigial oronasal duct tissue.
- **Clinical Features** Nasopalatine cyst is seen in fourth and fifth decades with male predilection. There is swelling in the anterior palate.
- Many lesions are asymptomatic and discovered only on routine radiographic examination.
- Pain and drainage of pus is seen if cyst is infected. Expansion may occur in the oral cavity if the cyst is enlarged extensively. It may cause numbness and burning sensation of oral mucosa if cyst causes pressure on nasopalatine nerve.

#### **Radiographic Features**

- Radiographic Features It appears as an area of midline radiolucency situated between roots of upper central incisor in nasopalatine canal. It can be round, oval or irregular in shape with curved margin. If the superimposition of anterior nasal spine occurs, cyst appears as heart shaped. Lamina dura of adjacent tooth is intact. It can cause resorption of root and displacement of teeth.
- Differential Diagnosis:
- It includes incisive fossa (radiolucency less than 6 mm), radicular cyst (pulp is non-vital) and median palatine cyst (radiolucent lesion is behind the incisive canal)



### Traumatic bone cyst

- Traumatic bone cyst is also called haemorrhagic bone cyst or simple bone cyst. It is simple benign type of cyst. Usually the lesion is common in jaws as well as skeleton. It results from trauma causing intraosseous haematoma which undergoes liquefaction resulting in cystic defect.
- Clinical Features It is most frequently reported in older age group with male predominance. Mandible is affected more than maxilla in the jaws. It is seen in premolar–molar area. It presents as painless swelling. Aspiration is negative. Teeth in the affected area are vital.

#### **Radiographic Features**

- Area of radiolucency is situated in canine, bicuspid and molar regions of mandible. The radiolucent lesion is well demarcated from the adjacent bone. Margin is well defined or ill defined with thin radio-opaque border. In some cases, as lesion extends between roots, the border becomes irregular and scalloped.
- Differential Diagnosis It includes radicular cyst (non-vital teeth), central giantcell granuloma (crosses the midline), myxoma (multilocular), ameloblastoma (multilocular) and odontogenic keratocyst (it expands along the bone).

# Thank you for your kind attention



### **DENTAL IMPLANTOLOGY**

Lecture 20

3<sup>rd</sup> level

By: Dr. Yusra H. Al mukhtar

Department of oral and maxillofacial surgery

### Dental implant

- Dental implant: is a device made of alloplastic (foreign) material implanted into the jaw bone beneath the mucosal layer to support a fixed or removable dental prosthesis.
- Dental implants are gaining immense popularity and wide acceptance because they not only replace lost teeth but also provide permanent restorations that do not interfere with oral function or speech or compromise the self-esteem of a patient.

### Dental implant

- Imaging plays an important part in dental implant procedures.
- The imaging modalities vary from standard projections to more complex radiographic techniques .
- Implant imaging provides accurate and reliable diagnostic information of the patient's anatomy at the proposed implant site.
- Standard projections include intra-oral (periapical, occlusal) and extra-oral (panoramic, lateral cephalometric) radiographs.

### Dental implant

- More complex imaging techniques includes computed tomography (CT), and cone beam computed tomography (CBCT).
- Multiple factors influence the selection of radiographic techniques for a particular case including cost, availability, radiation exposure, and patient's anatomy

### •The goals of imaging are

- To measure bone height and width (bone dimensions)
- ° To assess bone quality
- To determine the long axis of alveolar bone
- To identify and localize internal anatomy
- To establish jaw boundaries .To detect any underlying pathology.



### **INTRAORAL RADIOGRAPHY**

Intraoral radiography used is either periapical or occlusal radiography.

- It is usually done to determine the vertical height of bone, bone architecture and bone quality.
- Intraoral radiography is recommended for the use of single tooth implant



# The disadvantages of intraoral periapical radiography

- There is limited area of exposure, it can be used only in case of single-tooth implant.
- There is foreshortening and elongation of the image which results due to anatomical variation.
- It is very difficult to reproduce the same image as the technique is not standardized.

## PANORAMIC RADIOGRAPH

• In comparison with the intraoral radiography, panoramic radiography has got advantage of **broader visualization of the image**.

• But in case of panoramic radiography, sharpness and resolution is less.

• Panoramic radiography is also **helpful in preliminary estimation of bone height and position of inferior nerve canal. It is usually indicated when implant is planned for more than one teeth** 



### Disadvantages with the panoramic radiography

• It has got image size distortion, foreshortening and elongation.

 Dimensional accuracy منه الابعاد in the case of panoramic radiography is also limited due to superimposition of various structures.

• Horizontal image magnification with panoramic radiographs can be twice the actual size.

## **CBCT imaging in dental implant**

• CBCT is the most accurate radiographic means for dental implant planning.

• It allows for complete **3D evaluation of bone** architecture with high accuracy **and can be used for standardized estimation of bone quality**.

# According to the available literature, CBCT imaging is **not** required in cases

- ° 1-in which the clinical examination reveals sufficient bone width
- 2- where standard radiographic examination reveals adequate bone height and space for implant placement. However, many clinical situations demand additional CBCT examination for optimal preoperative implant planning.

### Imaging modality is useful in three phases

#### • Phase 1

• **Pre-prosthetic implant imaging**: Imaging in this phase determines the quantity, quality, and angulation of bone; relationship of critical structures to prospective implant sites; and the presence or absence of disease at the proposed surgical sites.

#### • Phase 2

• Surgical and interventional implant imaging: Imaging in this phase evaluates the surgical sites during and immediately after surgery, assists in the optimal positioning and orientation of dental implants, and ascertains the healing and integration phase of implant surgery. It also ensures appropriate abutment positioning and prosthesis fabrication

#### • Phase3

• **Post-prosthetic implant imaging** :This phase commences just after placement of the prosthesis and continues as long as the implant remains in the jaw. Imaging in this phase evaluates the long-term change, if any, in the implant's fixed position and function, including the **crestal bone levels** around each implant, and evaluates the status and prognosis of the dental implant. It also helps to routinely assess the bone adjacent to the dental implant to note any changes in mineralization or bone volume



# Thank you for your kind attention



### G\A

 $^\circ$  Q1 Computed tomography (CT) scanners consist of all, EXCEPT one. Which one is the EXCEPTION?

- A. X-ray source.
- B. X-ray detector.
- C. Rotating gantry.
- D. Image receptor cassette
- $\circ\,$  E. None of the above

#### $\circ\,$ Q2 Which is a horizontal plane that divides the body into superior and inferior peripheries?

- A. Sagittal.
- B. Dorsal.
- ° C. Coronal.
- D. Axial.
- E. All of the above

### G\B

# $^\circ\,$ Q1 . All are characteristics of dentigerous cysts, EXCEPT one. Which one is the EXCEPTION?

- A. Painless.
- B. Radiolucent.
- C. Fast growing.
- D. Well-defined cortex
- E. All of the above
- Q2Which is NOT a clinical feature of cysts?
- A. Swelling.
- B. Severe pain.
- C. Association with third molars.
- D. Association with unerupted teeth
- $\circ\,$  E. None of the above

### G\ C

- Q1. All are characteristics of a cyst, EXCEPT one. Which is the EXCEPTION?
- A. Rarely occur in condyle and coronoid process.
- B. Appear radiopaque on images.
- C. Occur centrally in maxilla or mandible.
- D. May grow into the maxillary antrum
- E. All of the above

#### • Q2Which is the MOST common epicenter of a radicular cyst?

- A. Distal surface of tooth.
- B. Apex of tooth involved.
- C. Mesial surface of tooth.
- D. Deep periodontal pocket.
- E. None of the above

### G \D

• Q1. Which lesion is associated with nonvital teeth resulting from large carious lesions, large restorations, or previous trauma?

- A. Dentigerous cyst
- B. Cemental dysplasia.
- C. Lateral periodontal cyst.
- D. Odontogenic kerato cyst
- E . Radicular cyst.

• Q2Which clinical feature of a nasopalatine duct cyst does NOT follow the path of diagnosis?

- A. Salty taste.
- B. Severe pain.
- C. Burning sensation.
- D. Well-defined swelling
- $\circ~E$  . None of the above

### G\E

 $\circ$  Q1Which term describes an odontogenic cyst that remains after incomplete removal of the original cyst?

- A. Odontogenic keratocyst
- B. Radicular.
- C. Dentigerous.
- D. Residual.
- E. None of the above
- 0
- Q2. Dentigerous cysts attach to which area?
- A. Root of involved tooth.
- B. Crown of involved tooth.
- C. Lateral aspect of tooth follicle.
- D. Cementoenamel junction of involved tooth
- $\circ\,\,E$  . All of the above

### G\F

- Q1.Which is not a clinical symptom of a salivary gland disorder?
- A. Pain.
- B. Swelling.
- C. Altered salivary flow.
- D. Swallowing abnormalities.
- E. all of the above
- Q2 The initial diagnostic technique for detecting salivary gland disorders is
- A. ultrasonography (US).
- B. plain film radiography.
- C. computed tomography (CT).
- D. magnetic resonance imaging (MRI).
- E. contrast radiography.

### **TRAUMATIC INJURIES**

Lecture 21 3

3<sup>rd</sup> level

By: Dr. Yusra H. Al mukhtar

Department of oral and maxillofacial surgery

# **Traumatic Injuries**

• Oral and maxillofacial injuries refer to injuries of the orofacial soft tissues, facial skeleton, teeth and associated specialised soft tissues within the head and neck region as a result of wounding or external violence. These injuries can lead to orofacial deformity and malfunction, greatly diminishing quality of life and worker productivity.

# Traumatic Injury to Teeth

- Traumatic dental injuries of teeth occur frequently in children and young adults.
- •Enamel infraction: An incomplete fracture (crack) of the enamel without loss of tooth substance.
- • Enamel fracture (uncomplicated crown fracture): A fracture with loss of enamel only.
- •Enamel–dentine fracture (uncomplicated crown fracture): A fracture with loss of enamel and dentine, but *not involving the pulp*.
- •Complicated crown fracture: A fracture involving enamel and dentine, and exposing the pulp.
- •Crown–root fracture: A fracture involving enamel, coronal and radicular dentine, and cementum.
- • Root fracture: A fracture involving radicular dentine, cementum and the pulp.

### **Radiographic Evaluation**

- Radiographic evaluation of dentoalveolar injuries should include a panoramic radiograph and periapical radiograph of involved teeth.
- The radiographic examination reveals the stage of root formation and discloses **injuries affecting root portion of the tooth and periodontal structures**.
- **Multiple periapical radiographs taken at different angles** are useful to demonstrate the root fractures that are minimally displaced.
- **Ideally three different radiographs** from different angles should be obtained for each traumatised tooth.


### Fractures of the Alveolar Process

Fractures of the alveolar process are found **predominantly in the anterior teeth and the premolar region.** These injuries may be isolated or may be seen in conjunction with traumatic injuries to teeth .

- Radiographic Features
- The fracture is readily identified in the intraoral periapical radiograph .
- Lateral extraoral radiographs best demonstrate the location of the fracture if some bone displacement has occurred .
- *More close the fracture to the alveolar crest*, greater is the possibility of presence of root fractures. Usually two radiographs produced with different projecting angles are required for the accurate diagnosis.

### Fracture of the Mandible

Despite the fact that the mandible is the largest and strongest facial bone, by virtue of its position on the face and its prominence, it is commonly fractured when maxillofacial trauma has been sustained Fracture of the Mandible According to the anatomical site The fractures can be classified according to the site of fracture and its incidence as follows:

- Symphyseal fractures and parasymphyseal fractures
- Body fractures .
- Gonial area or angle fractures .
- Condylar fractures (intracapsular) and subcondylar fractures
- Coronoid process fracture
- Dentoalveolar fracture



### Symphyseal fractures and parasymphyseal fractures







A, Unfavorable fractures resulting in displacement at fracture site caused by pull of masseter muscle.

B, Favorable fracture in which direction of fracture and angulation of muscle pull resists displacement

# **Radiographic Features**

• The radiographic examination of a suspected mandibular fracture may include intraoral or occlusal views, intraoral periapical radiograph, panoramic view, posteroinferior or submento vertex plain radiograph, reverse Towne view, lateral oblique radiograph and CT.

- The margins of the fractures usually appear as sharply **defined** radiolucent lines of separation that are confined to the structure of the mandible.
- The lateral oblique view of the mandible can be of help in the diagnosis *of ramus, angle and posterior body fractures*.

## **Radiographic Features**

- The posteroanterior (PA) view demonstrates any medial or lateral displacement of the fractures of ramus, angle, body or symphysis.
- The mandibular occlusal view demonstrates displacement in the lateral or medial direction of the body fractures and also shows the anterior or posterior displacement of the symphyseal fracture





**Comminuted fracture of body of mandible.** 



## Trauma to temporomandibular joint region

The complexity of the TMJ, as well as its anatomical proximity to other craniofacial structures, makes diagnosis and treatment specifically challenging.

- Classification of TMJ Region
- Fracture Relationship of condylar fragment with mandibular fragment:
- • Non-displaced
- • Deviated
- $\circ$   $\bullet$  Displacement with medial or lateral overlap
- • Displacement with anterior or posterior overlaps
- $\circ$   $\bullet$  No contact between the fractured segments
- Relationship between condylar head and glenoid fossa:
- • Non-displaced
- • Displacement
- • Dislocation





Lateral Override

Medial Override

## Lindahl classification(1977)

#### Anatomic location of the fracture

Condylar head Condylar neck Subcondylar

Relationship of condylar fragment to mandible

> Nondisplaced: Deviated Displacement with medial or fateral overlap Displacement with anterior or posterior overlap No contact between flactured segments

Relationship of condylar head & Jossa

Displacement Displacement Dislocation







## **Radiographic Features**

 Radiographic Features At least two radiographs must be obtained at right angle to each other to adequately evaluate the TMJ region. Orthopantomography (OPG) and lateral oblique view of mandible

• **Panoramic radiograph** contains higher accuracy in detecting all the mandibular fractures. If OPG facilities are not available, **lateral oblique view** is more informative

- **Reverse Towne view and PA mandible**: It shows condylar head much better than more conventional PA or AP view of mandible in which these structures tend to be superimposed by base of the skull.
- **Transcranial and transorbital view of TMJ**: This view may occasionally be helpful in defining the relationship of the condylar proximal fragment to the glenoid fossa.
- **CT scan**: In difficult cases, CT scan has been demonstrated to show changes in **the relationship of the condyle to the mandibular fossa** more precisely than the conventional radiographic examination. Middle third fracture of face
- Fracture of Maxilla Middle third consists of maxilla, zygomatic bones and zygomatic process



## •Middle third fracture of face

## • Fracture of Maxilla

Middle third consists of maxilla, zygomatic bones and zygomatic process of temporal bones, palatine bone, nasal bone, lacrimal bone, inferior conchae, pterygoid plates, sphenoid, vomer and ethmoid. Fractures of the midface, often classification owing to the severity of the force and the multidirectional source of the trauma.

## • Classification : According to Rene Le Fort

• Le Fort I

• It is also known as **low-level fracture/horizontal fracture of maxilla/Guerin fracture/floating fracture/horizontal fracture above the level of nasal floor.** 

## • Radiographic Features

- Le Fort I this type of fracture is identified on PA, lateral skull and Water projections. Both maxillary sinuses are cloudy and may show air-filled level.
- Lateral view shows slight posterior displaced fragments.





#### • Le Fort II

• Le Fort II fracture is also known as pyramidal/

#### • sub zygomatic fracture.

- This fracture runs from the thin middle area of the nasal bones down to either side crossing the frontal processes of maxilla into the medial wall of each orbit.
- Radiographic Features
- Le Fort II It will reveal fracture of the nasal bone and both frontal processes of maxilla and infraorbital rims on both sides or separation of zygomatic sutures on both sides





#### • Le Fort III

- Le Fort III fracture is also called **high transverse/supra zygomatic fracture.**
- The fracture runs from near the frontonasal suture transversely, parallel with the base of the skull and involves the full depth of the ethmoid bone, including the cribriform plate
- Radiographic Features
- CT coronal and sagittal scans are the most useful imaging aids in determining the extent of the injuries





# Thank you for your kind attention



## **INFECTION CONTROL**

Lecture 22

3<sup>rd</sup> level

#### By: Dr. Yusra H. Al mukhtar

Department of oral and maxillofacial surgery

## **Infection Control**

- Dental personnel and patients are at increased risk for acquiring tuberculosis, HIV, herpes viruses, upper respiratory infections, and hepatitis strains A through E.
- The primary goal of infection control procedures is to prevent cross contamination and disease transmission from patient to staff, from staff to patient, and from patient to patient.

# The potential for cross-contamination in dental radiography is great. **Cross contamination can be happened in different way:**

- 1. An operator's **hands** become contaminated by contact with a patient's mouth and saliva-contaminated films and film holders. Then the operator also must adjust the x-ray tube head and x-ray machine control panel settings to make the exposure.
- 2. An operator handles digital sensors or opens film packets to process the films in the darkroom.
- The dentist is responsible for minimizing or eliminating cross-contamination procedures. And responsible also to educates other members of the practice

## Key Steps in Radiographic Infection Control

- • Apply standard precautions
- • Wear personal protective equipment during all radiographic procedures
- • Disinfect and cover x-ray machine, working surfaces, chair, and apron
- • Sterilize non disposable instruments
- • Use barrier-protected film (sensor)
- • Prevent contamination of processing equipment

## 1. Standard Precautions احتياطات قياسية

 Standard precautions (also called universal precautions) are infection control practices designed to protect workers from exposure to diseases spread by blood and certain body fluids, including saliva. Under standard precautions, all human blood and saliva are treated as infectious for human immunodeficiency virus (HIV) and hepatitis B virus.

## 2. Wear Personal Protective Equipment During All Radiographic Procedure

- Personal **protective equipment** is an effective means to shield the operator from exposure to potentially infectious material, including blood and saliva.
- **Hand hygiene** is most important to prevent spread of infections. After the patient is seated, the hand should be washed using plain or antimicrobial soap. Alcoholbased hand rubs are also effective.
- **Disposable gloves** should be worn in sight of the patient. The operator should always wear gloves when making radiographs or handling contaminated film or when removing barrier protections from surfaces and radiographic equipment.
- • Operators should **wear protective clothing** (e.g., disposable gown or laboratory coat) that covers clothes and skin to protect against potential contamination.

## 3. Disinfect and Cover Clinical Contact Surfaces

- Clinical contact surfaces are surfaces that might be touched by gloved hands or instruments that go into the mouth. These include the x-ray machine and control panel, chair-side computer, beam alignment device, dental chair and headrest, protective apron, thyroid collar, and surfaces on which the receptor is placed. These are noncritical items. The goal of preventing crosscontamination is by disinfecting all such surfaces and by using barriers to isolate equipment from direct contact.
- Barriers made of clear **plastic wrap should cover working surfaces** that were previously cleaned and disinfected, and should be changed when damaged and routinely after each patient. Intermediate- and low level activity disinfectants recommended for use on clinical contact surfaces.



FIG. 16.6 The exposure control console should be covered with a clean barrier and changed after every patient.

FIG. 16.8 A plastic bag is slipped over the x-ray tube head with a large rubber band just proximal to the swivel or tie ends, as shown here. The plastic is pulled tight over the position-indicating device (PID) and secured with a light rubber band slipped over the PID and placed next to the head.

FIG. 16.9 Hanging apron is sprayed with disinfectant and then dried and covered with a garment bag.







- Panoramic chin rest and patient handgrips should be cleaned with a low-level disinfectant. **Disposable bite blocks** may be used. The head-positioning guides, control panel, and exposure switch should be carefully wiped with a paper towel that is well **moistened with disinfectant**.
- Cephalostat ear posts, ear post brackets, and forehead support or nasion pointer should be cleaned and disinfected. These may then also be covered with a plastic barrier.
- After patient exposures are completed, the barriers should be removed, and contaminated working surfaces (including surfaces in the darkroom) and the apron should be sprayed with disinfectant and wiped as described previously. The barriers should be replaced in preparation for the next patient.

## 4. Sterilize Non disposable Instruments

• Film -holding instruments are classified as semicritical items —instruments that are not used to penetrate soft tissue or bone but do come in contact with the oral mucous membrane. It can be sterilized by steam under pressure (autoclave).

## 5. Use Barriers With Digital Sensors

Digital **Sensors cannot be sterilized by heat**, so a **plastic barrier used** to protect them from contamination when placed in the patient's mouth.

### ° 6. Prevent Contamination of Processing Equipment

After all film exposures are made, the operator should remove his or her gloves and take the container of contaminated films to the darkroom.
The goal in the darkroom is to break the infection chain so that only clean films are placed into processing solutions. Two towels should be placed on the darkroom working surface. The container of contaminated films should be placed on one of these towels. After the exposed film is removed from its packet, it should be placed on the second towel. The film packaging is discarded on the first towel with the container



FIG. 16.10 Film-holding instrument with barrier wrapping to protect sensor and cord from saliva. (Image courtesy Dentsply Rinn.



FIG. 16.12 Method for removing films from packet without touching them with contaminated gloves. (A) Packet tab is opened, and lead foil and black interleaf paper are slid from wrapping. (B) Foil is rotated away from black paper and discarded. (C) Paper wrapping

## الميزان ٨

#### %51

#### ويشمل 10 محاضرات

NO.	Lecture name	weight	Hour(
1	Radiation physics	5%	2
2	Image receptor	6%	2
3	Intraoral radiographic techniques	7%	2
4	Radiography of patients with special needs	6%	1
5	Patient's management	6%	1
6	Radiographic appearance of common dental diseases	5%	1
7	Panoramic radiography	5%	1
8	Cysts of the jaw	3%	1
9	Dental and craniofacial anomalies	5%	1
10	Traumatic Injuries	3%	1

#### ويشمل 10 محاضرات

%34

ميزان محاضرات منهاج اشعة الفم المرحلة الثالثة

قسمت محاضر ات المنهاج لمادة اشعة الفم الى ثلاث مستويات A, B and C

الميزان B

محاضرات اشعة الفم المرحلة الثالثة

NO.	Lecture name	weight	Hour(
1	Dental X-ray film processing	3%	1
2	Factors relating to the production of radiograph	3%	1
3	Image Characteristics	3%	1
4	Dental digital imaging	4%	1
5	Extraoral radiography	5%	1
6	Computed tomography and cone beam computed tomography	3%	1
7	Advanced imaging modalities	4%	1
8	Dental implantology	3%	1
9	Salivary gland imaging	3%	1
10	Guidelines for prescribing radiographs	3%	1

#### الميزان C 15% ويشمل 4 محاضرات

NO.	Lecture name	weight	Hour(s)
1	Intraoral technique, projection and processing errors	4%	1
2	Normal radiographic anatomical landmarks	4%	1
3	Biological effects of radiation	4%	1
4	Infection Control	3%	1
## Thank you for your kind attention



**Advanced Imaging Modalities** 

Lecture 23

3<sup>rd</sup> level

By: Dr. Yusra H. Al mukhtar

Department of oral and maxillofacial surgery

## **Advanced Imaging Modalities**

- The advanced imaging modalities employ equipment and principles that are beyond the routine needs of most general dental practitioners which include:
- $\circ~$  Magnetic resonance imaging MRI
- $\circ~$  Ultrasonography US
- $\circ~$  Computed tomography CT (will discuss in another lecture with CBCT)

### Magnetic Resonance Imaging (MRI)

 Magnetic resonance imaging (MRI) is an imaging technique with a revolutionary impact in diagnostic imaging. it is noninvasive and uses nonionizing radiation. Instead, it depends on the magnet and radio frequency waves (RF)

### MRI principle and technique:

- The essential principle of MRI involves the behavior of protons (positively charged nuclear particles) in the simplest atom which is **hydrogen** that consisting of one proton in the nucleus so it used to create the MRI image
- **To make an MR image**, the patient is first placed inside a large magnet. This magnetic field causes the nuclei of many atoms in the body, particularly hydrogen, to align with the magnetic field. The scanner directs a radiofrequency (RF) pulse into the patient, causing some hydrogen nuclei to absorb energy (resonate). When the RF pulse is turned off, the hydrogen nuclei release the stored energy, which is detected as a signal in the scanner. The magnetic field in MRI scanner is provided by external powerful permanent magnet with strength range from (0.1 to 7 Tesla), 1.5 Tesla is the most commonly used (which is about 30,000 times the strength of the earth's magnetic field).

## Advantages of MRI

- 1. It offers **best contrast** resolution of soft tissues
- 2. **No ionizing** radiation is involved, with no adverse effects have yet been demonstrated
- 3. Direct multi planar imaging is possible without patient re-orientation, image manipulation can be done.

### Disadvantages of MRI

- 1. Relatively long imaging times
- 2. Patients with claustrophobia may not be able to tolerate the narrow space within the MRI scanner this can be managed by using open MRI, chemical sedation, general anesthesia, or listening to music on headphones.
- 3. Hazard associated with the presence of ferromagnetic(metal)substances in the patient's body, the strong magnetic fields can move these objects, cause excessive heating, or induce strong electrical currents, which may harm the patient, so MRI is contraindicated in patients with cardiac pacemakers, some cerebral aneurysm clips, vagus nerve stimulators, insulin pumps, cochlear implants, and in patients with embedded ferrous foreign bodies, such as shrapnel or bullets.
- 4. Metals dental restorations do not move but distort the image, Removable dental appliances must be removed prior to MRI scanning.
  Special considerations to patients with Steel orthodontic archwires treatment
- 5. There is medical evidence that a tattoo can cause a reaction (burning sensation) during MR imaging because some tattoo inks containing iron oxide
- 6. Contraindicated In first trimester of pregnancy (especially with using Gadolinium contrast agent)

### Applications of MRI in Maxillofacial Diagnosis

- Because of its excellent soft-tissue contrast resolution, MR imaging is useful in evaluating soft tissue conditions (Bone does not give an MR signal, a signal is only obtainable from bone marrow).
- Applications of MRI in dentistry include:
- 1. Evaluation of TMJ
- 2. Evaluation of neoplasms
- 3. Evaluation of salivary gland diseases
- 4. Evaluation of vascular lesions in the orofacial region
- 5. Evaluation of early jaws osteomyelitis
- 6. Evaluation of maxillary sinus, nasal cavities, the tongue, and floor of mouth
- 7. Functional MRI (fMRI) which isidentification of motor and sensory areas of the brain in relation to pain, occlusion, fear, love, smell,...

### **CT versus MRI**

	CT.	MRI
1	uses X-rays (ionizing radiation) it a good tool for examining hard tissue such as bone	uses non-ionizing radio frequency (RF) signals is best suited for soft tissue
2	contrast in CT images is generated from X-ray attenuation	variety of properties may be used to generate contrast in MR images.
3	Contrast agents is iodine or barium	Contrast agents is gadolinium
4	limited to axial plane images from which images reconstructed in any plane	generate cross-sectional images in any plane
5	best for solid tumors of the abdomen and chest	Best For brain tumor detection
6	more widely available, faster, and less expensive	Long time, expensive

## Ultrasonography (US)

Is an advanced modality in oral and maxillofacial imaging, this technique **based on sound waves** that acquires images in real time without the use of ionizing radiation.

### **US principle and technique:.**

• The US unit consists of a transducer and the monitor on which sonogram can be seen. A transducer محول الطاقة is a device that can convert electrical energy into sonic الى طاقة صوتية energy with frequencies تردد range ( 1 to 20 MHz). The transducer emitting ultrasound is held against the body part being examined. The ultrasonic beam passes through or interacts with tissues of different acoustic impedance. some Sonic waves are reflected and the rest are absorbed The sound waves travel fast through the first tissue layer until they meet a different tissue, that reflect (echo) toward the transducer are detected by the transducer, amplified, processed, and displayed on monitor as a digital image. Interpretation of sonograms relies on the tissues signals. Tissues that do not produce signals, such as fluid-filled cysts, are said to be anechoic and appear black. Tissues that produce a weak signal are hypoechoic ناقصة الصدى, whereas tissues that produce intense signals, such as ligaments, skin, or needles or catheters, are hyperechoic and appear bright

# Applications of ultrasonography in oral and maxillofacial imaging

- 1- Evaluation of benign and malignant masses of neoplasms in head and neck region (the thyroid, parathyroid, lymph nodes, sinuses)
- 2- Salivary glands pathologies (neoplasm, stones, inflammation, and Sjögren's syndrome)
- $\circ$  3- Evaluation of vessels of the neck, including the carotid artery for atherosclerotic plaques
- 4- Ultrasonography is also used to guide fine-needle aspiration.
- $\circ$  5- More recent advances include 3D imaging of a fetal face
- 6- Color Doppler sonography for evaluation of blood flow
- 7- Detection of Orofacial Fracture
- 8- Detection of facial muscles thickness



US device



Transverse section of the submental region shows a small hyperechoic structure, a sialolith(stone), green arrow.

## Thank you for your kind attention



#### **Image Characteristics**

- Visual Characteristics: (Density, Contrast)
- Geometric Characteristics: (Sharpness, Magnification, Distortion, Image Resolution)

#### **A-Geometric characteristics**

#### -Sharpness

Sharpness of the radiographic image refers to how well a boundary between two contrasting radiodensities is delineated. Sharpness depends on focal spot size, film composition, and any movement of the subject or film during exposure.

**Penumbra**: Is the amount of un sharpness of the image so penumbra is the area of partial shadow. **Umbra**: Is the area of total shadow and its exist only when the object absorb all of X - rays.

**Penumbra is created by** the size of focal spot (source of radiation), the larger the spot size the greater is the penumbra (the amount of un sharpness). **penumbra not only affected by focal spot size but also affected by tube – object distance and object – film distance so** the closer tube – object distance the greater is the penumbra while the closer object – film distance the lesser is the size of penumbra.





(Increase the tube – object distance lead to increase sharpness and decrease of magnification)



(decrease the object- film distance lead to increase sharpness and decrease of magnification)

#### -Magnification

Magnification is the term given for a radiographic image which appears larger than the actual size of the object which was radiographed. it occurs due to the divergent nature of the x-ray beam. factors influencing magnification are

- 1- decrease in target to object distance and increase in object to film distance
- 2- large effective focal spot.



#### -Distortion

it refers to a variation in the size or shape of the object being radiographed.

factors contributing to the distortion of the image are:

1-improper object-film alignment )ideally the object and film must parallel to each other)

2-improper x-ray beam angulation (ideally the central x-ray beam should be perpendicular to the object and the film

**-Image Resolution** it is a measure of visualization of relatively small objects that are close together as separate objects.

Sharpness and resolution are determined by the same geometric variables



#### Factors influencing diagnostic quality Of a radiograph

- •Milliamperage (mA)
- •Kilovoltage peak (kVp)
- •Exposure time
- •Density of the object
- •Speed of the film
- •Collimation
- •Source to object distance
- •Object to film distance
- •Inverse square law
- •Ideal technique and processing conditions
- •Good quality of x-ray film
- Use of small effective focal spot.

#### **Causes of Faulty Radiographs**

Faulty radiographs are of no diagnostic value as they do not provide adequate detail and required information. A diagnostic radiograph is one that provides a great deal of information; the images have proper density and contrast, have sharp outlines, and the structures are of the same size and shape as that of the object radiographed. The Causes

of Faulty Radiographs radiographic images are due to:

- Faulty Radiographic Techniques.
- Faulty Processing Techniques.

Accordingly, there can be partial or total absence of images, films are light, dark, yellowbrown and fogged; or there are scratched emulsion or fingerprints

#### Faulty radiographs resulting from faulty radiographic techniques

#### **1-Foreshortening of the Image**

Foreshortening or shortening refers to images of the teeth and other structures that appear too short. In an ideal radiograph, the structures imaged should have the same size and shape. Foreshortening results from excessive vertical angulation of the x-ray tube during radiography. Foreshortening of the image can adversely affect the treatment planning as well as the outcome of the treatment.



#### **2-Elongation of the Image**

Elongation refers to images of the teeth and associated structures that appear too long than real.it results from decreased vertical angulation.



#### **3-Overlapping of Proximal Surfaces**

it results from improper horizontal angulation. it makes the radiographs of less diagnostic value, especially in the detection of proximal caries.



#### 4-Slanting of Occlusal Plane or Incisal Plane

In an ideal radiograph, the occlusal plane or incisal plane should be parallel to the margin of the film. Slanting of occlusal plane results from improper placement of the film in the patient's mouth.



#### 5-Image of Coronal Portion of the Teeth not Seen Completely (cut off)

Sufficient area of the film should be visible between the incisal or occlusal plane and the margin of the film. This is to ensure that the image of the coronal portion of the teeth is seen fully.



#### 6-Image of the Apical Region not Seen (cut off)

Sufficient area of the periapical region should be visible for better diagnosis and evaluation of any pathology involving the periapical region. Cut off, due to improper placement of the film in the patient's mouth.



#### **7-Blurred or Distorted Image**

refers to image which appears hazy and without any sharpness.it is due to either the movement of the patient, the film in the patient's mouth, or the x-ray tube during exposure.



#### 8- Cone-cut Appearance

it refers to a clear, unexposed area in a dental radiograph. Caused when x-ray beam not centered over the film, ( central x-ray not perpendicular to the center of the film.



#### 9-Phalangioma

It refers to the image of phalanx of finger appearing in the film, due to incorrect film holding way leading to the appearance of the image of the fingers in the radiograph. with finger-holding method of intraoral radiography, it is not advised as per the radiation protection protocols.



#### **10- Double Exposure or Double Image**



refers to appearance of two separate images in the radiograph, due to repeated exposure of an already exposed film.

#### 11- Reversed Film

refers to a film exposed from the opposite side If the film is placed in the mouth reversed and then exposed, the x-ray beam gets attenuated by the lead foil backing in the film packet. It decreases the amount of x-ray beam exposing the film. This results in light images with herringbone or tyretrack or car-tyre appearance in the radiograph. This pattern is due to the actual pattern embossed on the lead foil.



#### **12-Film Creasing**

It result either in cracking of emulsion or a thin radiolucent line appears in the radiograph.

#### 13-Crimp-marks

or nail-like curved dark lines result from sharp bending of the film.



#### 14- Light Image

A light image is devoid of proper contrast. A decrease in the exposure time, mA, or kVp results in a light image. Apart from the decrease in these factors, certain processing

errors can also result in light image..

#### 15- Dark Image

It results from excessive exposure time, mA, or kVp. Apart from these factors, certain processing parameters can also result in a dark image.



#### Faulty radiographs resulting from faulty processing techniques

#### **1-Light Image**

Apart from less exposure time, mA, and kVp, a light image can also result from inadequate development time, inaccurate timer, low developer temperature, and depleted or contaminated developing solution.



#### 2-Dark Image

A dark image is the result of excessive development time inaccurate timer, higher developer temperature, and concentrated developer solution.



#### **3-Cracked or Reticulated Image**

It results when the film is subjected to a sudden temperature change between the developer and the water bath.



#### 4- Dark Spots on the Film

(developer spots) on the film occur due to droplets of developing solution coming in contact with an exposed film before it is developed.



#### 5- White Spots on the Film

Or (fixer spots) on the film results from droplets of fixing solution coming in contact with an exposed film before it is developed



#### 6-Blank Film

refers to total absence of image. The film appears translucent as the entire emulsion is washed off. This results from immersing the exposed film in the fixing solution before it is immersed in the developing solution



#### 7-White Area on the Film

When two films come in contact with each other during development, the overlapped portion appears whiter.



#### 8-Dark Areas on the Film

Dark areas appear on film when overlap has occurred in the fixer.

#### 9-Straight White Border

If the level of the developing solution is too low, the film will not be fully immersed in the developer, resulting in a straight white border representing the undeveloped portion of the film.



#### **10-Straight Black Border**

If the level of the fixer is too low, in the unfixed portion of the film, straight black border appears.

#### **11-White Marks on the Film**

When air bubbles are trapped on the film surface, the processing solution does not come in contact with the film



#### 12-Nail Marks

it crescent-shaped when the emulsion is damaged by the fingernail due to rough handling of the film



13-Thin Black Branching Lines or Tree-like Appearance

This appearance results from static electricity exposing the film due to the following reasons:

- •Opening of the film packet too quickly
- •Humid conditions
- •Rubbing of the film with the intensifying screen.



#### **14-Fingermarks**

Fingermarks on the film result from handling the film with wet finger



#### **15-Scratched Emulsion**

When the film comes in contact with sharp objects, the emulsion in that area is removed, causing scratched emulsion as in these areas the emulsion has peeled off.



#### **16-Light Exposure**

Due to light exposure, the exposed portion of the film appears black.

#### 17-Fogged Film

it refers to a film which appears gray without image detail and contrast. results from improper safe lighting conditions, light leakage, improper storage conditions of the film, expired or outdated film, contaminated processing solution, or high temperature of the developer.

