RADIOGRAPHIC TECHNIQUES

LECTURE BY,

Dr. SWATI GOYAL

TERMINIOLOGIES:

- ***Radiation:*** **A form of energy carried by waves or a stream of particles**
- ***X-radiation:*** **A high energy radiation produced by the collision of a beam of electrons with a metal target in an X-ray tube**
- ***X-ray:*** **A beam of energy that has the power to penetrate substances and record image shadows on photographic film**
- ***Radiology:*** **The science or study of radiation as used in medicine, a branch of medical science that deals with the use of X-rays, radioactive substances and other form of radiant energy in the diagnosis and treatment of disease**

- *Dental radiograph:* A photographic image produced on film by the passage of X-ray through teeth and related structure
- *Dental radiography:* The making of radiographs of the teeth and the adjacent structures by the exposure of film to X-ray
- *Dental radiographer:* A person, who positions, exposes and processes dental X-ray film
- *Density:* The overall degree of darkening of exposed film
- *Latitude:* Measure of range of exposure that will produce distinguishable densities on film

- ***Film speed:*** **Amount of radiation needed to produce a standard density**
- ***Contrast:*** **The difference in densities between various areas on**

  radiograph
- ***Resolution:*** **Ability to distinguish between small objects that are close together**
- ***Radiographic mottle:*** **Appearance of uneven densities of an exposed film**
- ***Sharpness:*** **Ability of a radiograph to define an edge**

HISTORY:

1895	Discovery of x-rays	WC Roentigen
1896	First dental radiograph	Otto Walkhoff
1896	First dental radiograph (USA-skull)	WJ Morton
1896	First dental radiograph (US-live pt)	CE Kells
1901	First paper on dangers of X-radius	WH Rollins
1904	Introduction of bisecting techniques	WA Price
1913	First prewrapped dental films	Eastman Kodak comp

1913	First X-ray tube	WD Coolidge
1920	First machine made film packets	Eastman Kodak comp
1923	First dental X-ray machine	Victor X-ray Co-op-Chicago
1925	First dental text	HR Raper
1925	Introduction of bitewing technique	HR Raper
1947	Introduction of long cone 11th technique	FG Fitzgerald
1957	First variable kilovoltage dental X-ray	General electric machine

CHARACTERISTICS OF AN IDEAL RADIOGRAPH:

- ***Radiographic density:*** **Which refers to overall degree of darkening of various regions. It should not be very darker or very light.**
- ***Latitude of the film:*** **It is the measurement of range of exposure that may be usefully recorded as a sum of distinguishable density on the film.**
- ***Adequate radiographic contrasts:*** **Difference in density of various regions, thus helping in demarcating the structures.**

- *Speed of the film:* This refers to the amounts of radiation, required to produce a radiographic film of a standard density.
- *Sharpness:* It is the effectiveness of a radiograph to precisely mark the edge.
- *Resolution:* This describes the ability of radiograph to record separate structures that are close together.
- *Image quality:* Overall appearance of radiograph.

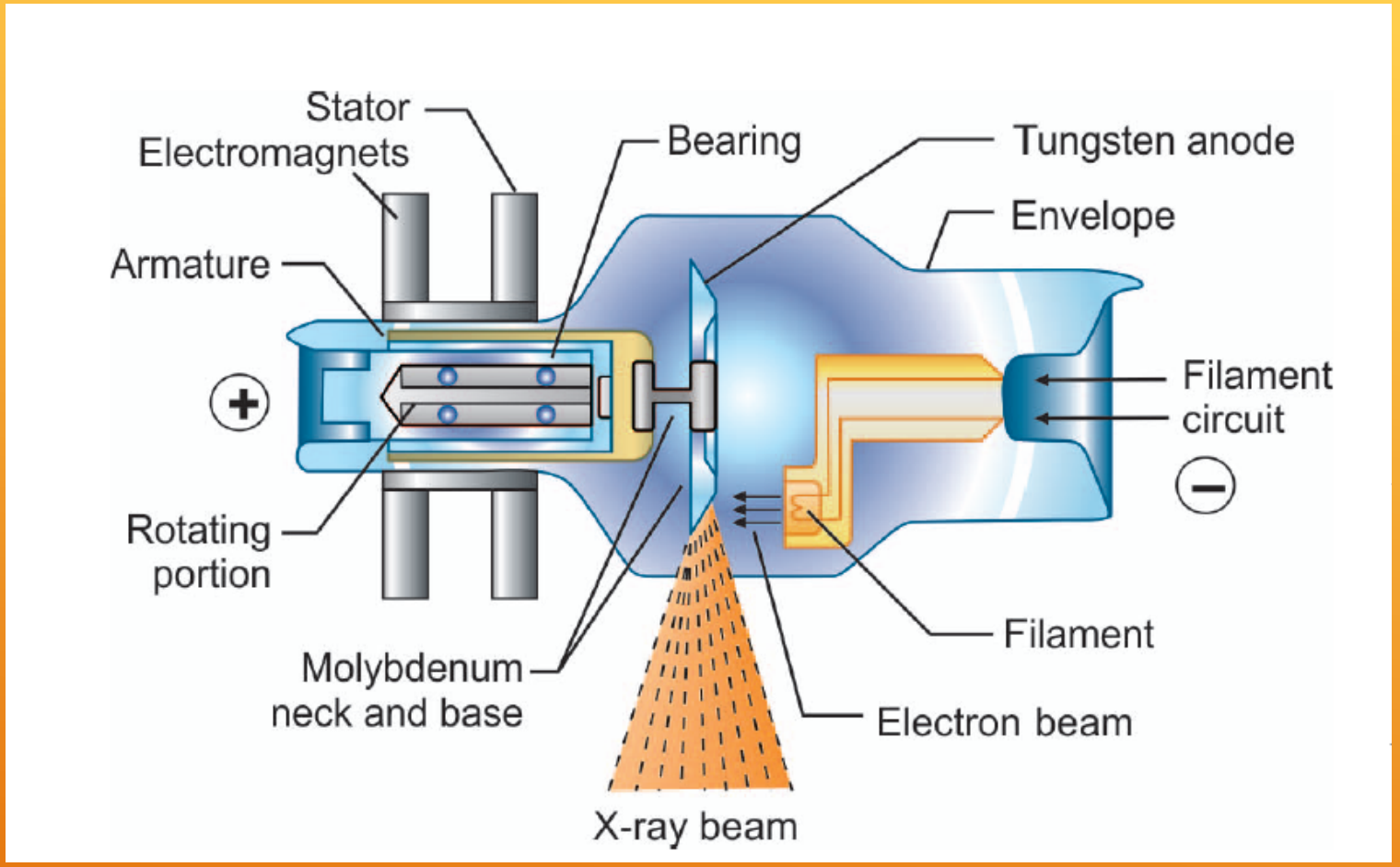
USES OF X-RAY:

- X-rays are used in health sciences for
- diagnosis and therapeutic purposes
- In industries for casting and welding
- Used in preservation of food
- Spectroscopy– Identification of elements, their atomic number, etc.
- Photochemistry– Ionization of chemicals for oxidation and reduction purpose
- Radiobiology
- Crystallography– Analysis of molecules
- Sterilization of instruments
- Autoradiography

- To detect lesions, disease and conditions of the teeth and surrounding structures that cannot be identified clinically
- To confirm or classify suspected disease
- To localize lesions or foreign objects
- To provide information during dental procedures (e.g. root canal therapy)
- To evaluate growth and development
- To illustrate changes secondary to caries, disease and trauma
- To document the condition of a patient at a specific point of time

- Caries
- Pulp pathology
- Traumatic injuries
- Problems of eruption
- Anomalies of developments
- Orthodontic evaluation
- History of pain
- Evidence of swelling
- Unexplained tooth mobility
- Unexplained bleeding
- Deep periodontal pocket
- Fistula formation

- Unexplained sensitivity of teeth
- Evaluation of sinus condition
- Unusual spacing or migration of teeth
- Lack of response to conventional dental treatment
- Unusual tooth morphology calcification/color
- Evaluation of growth abnormality
- Altered occlusal relationship
- Aid in diagnosis of systemic disease
- Family history of dental anomalies
- Postoperative evaluation



X-RAY MACHINE

- ***Control panel:*** **This consists of an on/off switch, indicator lights, an exposure button and control devices (Time, Kvp,mA) to regulate the X-ray beam. The control panel is plugged into an electrical outlet and appears as a panel or cabinets that are mounted.**
- ***Extension arm:*** **The wall mounted extension arm suspends the X-ray tube head and houses the electrical wires. The purpose of the cathode is to supply the electrons necessary to generate X-rays**

- *Cathode:* Produced the electrons that are accelerated towards the positive anode. This includes tungsten filaments or coiled wire made of tungsten, which produces electrons when heated and a molybdenum cup, which focuses the electrons into a narrow beam and directs the beam across the tube towards the tungsten targets of the anode.
- *Anode:* A positive electrode consists of a wafer thin tungsten plate embedded in a solid copper rod with the purpose of converting electrons into X-ray photon. It includes a tungsten target, or plate of tungsten, which serves as a focal spot and converts bombarding electron into X-ray photons and a copper stem, which functions to dissipate the heat away from the tungsten target.

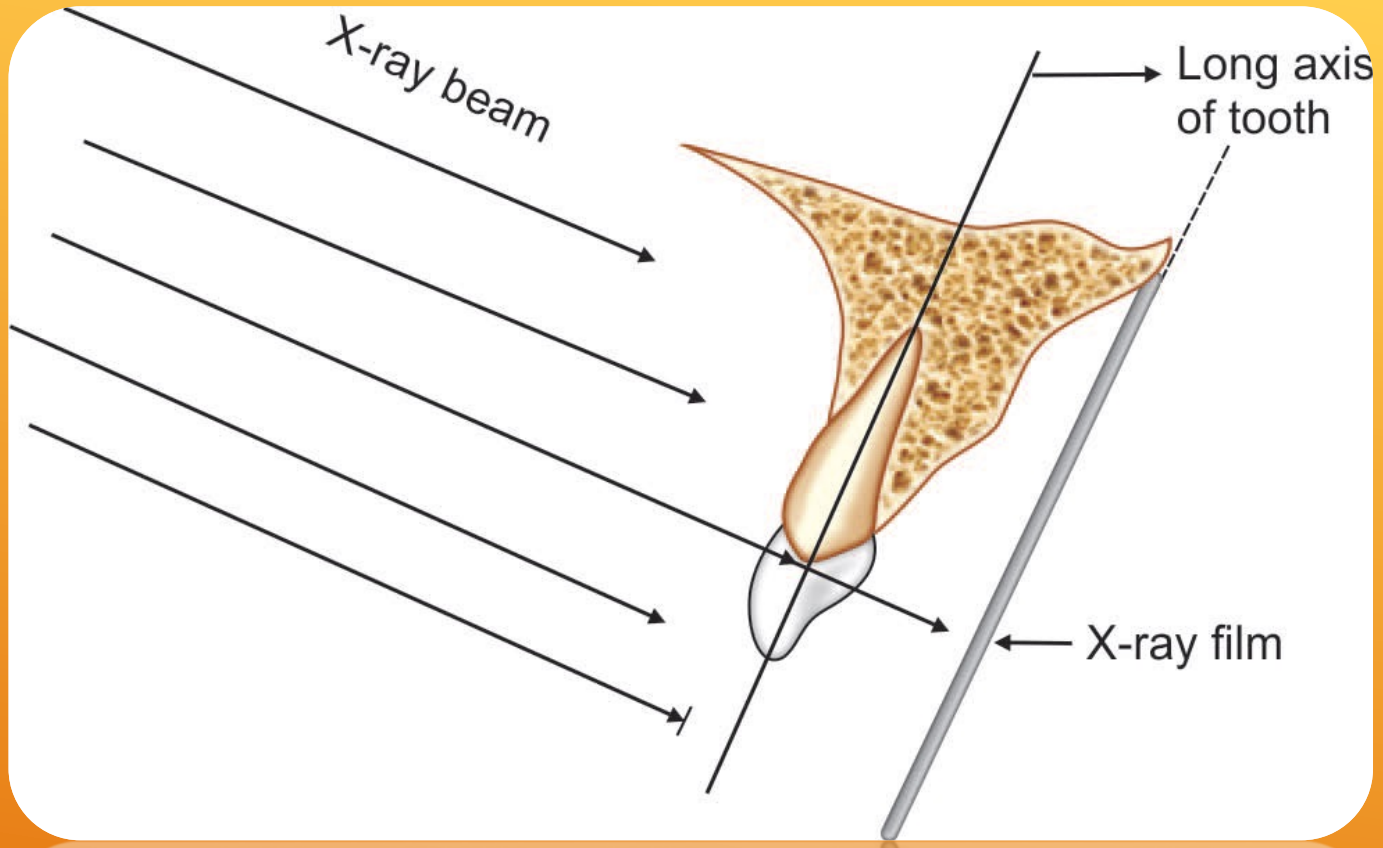
- ***Amperage*: It is the measurement of the number of electrons moving through a conductor.**
- ***Voltage*: It is the measurement of electrical force that causes electrons to move from negative pole to a positive one.**

PROPERTIES OF X-RAYS:

- *They are invisible*
- *They travel at the same speed of light – 3 × 108 m/sec*
- *They travels in a straight line*
- *They cannot be deflected*
- *They affect photographic plates*
- *They produces fluorescence with some substances, e.g. Bariopalladium crystals*
- *They can penetrate opaque objects.*

ITRAORAL PERIAPICAL RADIOGRAPH TECHNIQUE:

- **PARALLELING TECHNIQUE**
- **BISECTING ANGLE TECHNIQUE**



PARALLELING TECHNIQUE:

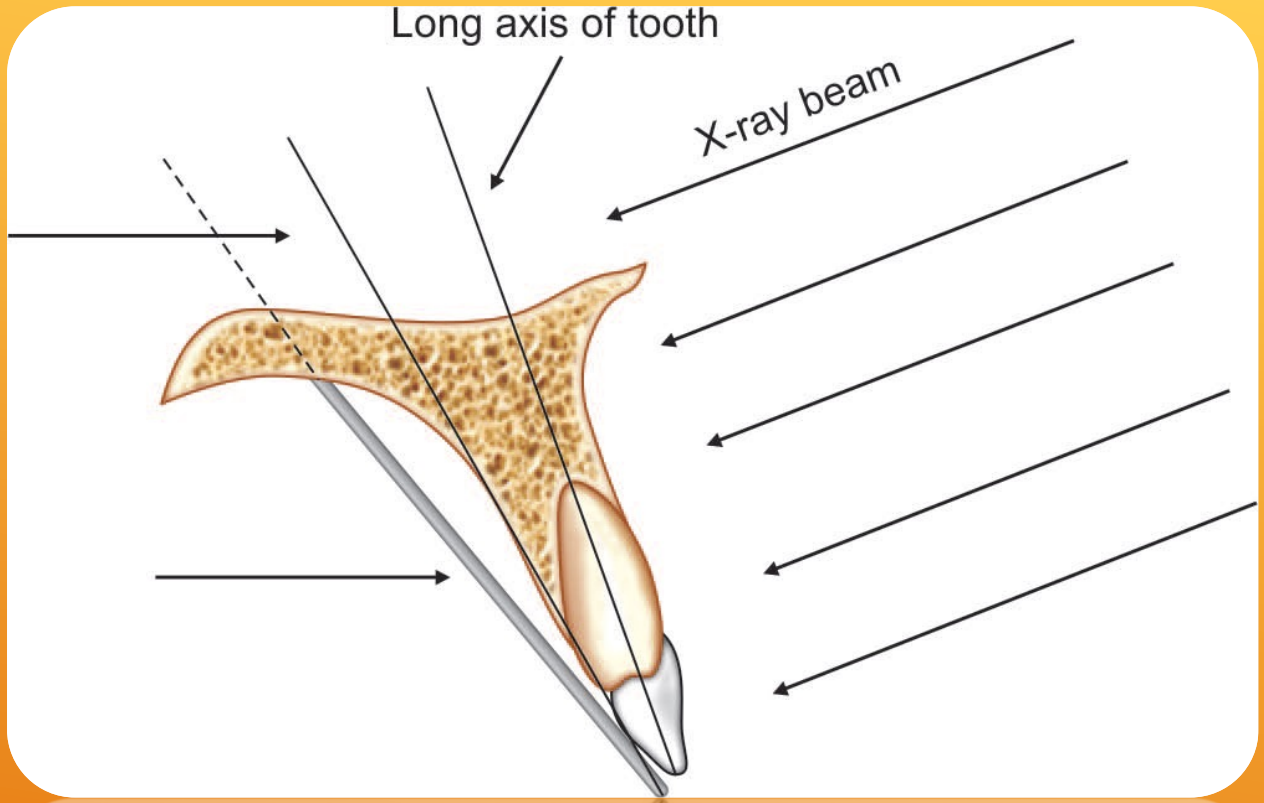
- *Also called long cone technique*
- *Pioneered by Gordon Fitzgerald, Father of modern radiology*
- *Central ray should be focused perpendicular to long axis of the film with the X-ray film being parallel to long axis of tooth*
- *Film holders like XCP are used*
- *More accurate*
- *In case of children film is placed within 20° of the parallel to the long axis, with the beam directed to the film.*

Advantages

- Accurate images can be obtained with minimum magnification.
- Interdental bone levels are very well represented.
- Periapical tissue will be accurately shown with minimal foreshortening or elongation.
- Horizontal and vertical angulations are automatically determined by positioning device.
- X-ray beam is aimed correctly at the center of the film and prevents cone cut

Disadvantages

- **Positioning of the film packet is very uncomfortable for patient especially in the posterior aspect of teeth, often causing gagging.**
- **Positioning the holder in the mouth will be difficult for inexperienced operators.**
- **Anatomy of mouth sometimes makes the technique difficult.**
- **Positioning the holders in the lower 3rd molar region can be very difficult.**



BISECTING ANGLE TECHNIQUE:

- *Also called short cone technique*
- *Pioneered by Weston Price*
- *Film is placed close to the teeth and central ray is directed at right angles to the line bisecting the angle formed by the plane of the film and the long axis of the tooth*

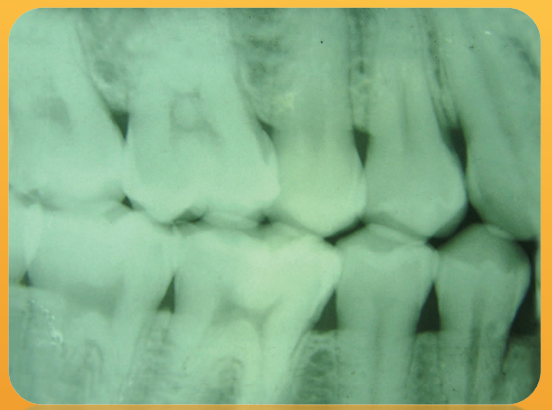
Advantages

- **Positioning of film or film packet will be reasonably comfortable for patient and for operator in all areas of mouth.**
- **Positioning of film is simple and quick.**
- **If we give proper angulation there will not be any distortion of image.**

Disadvantages

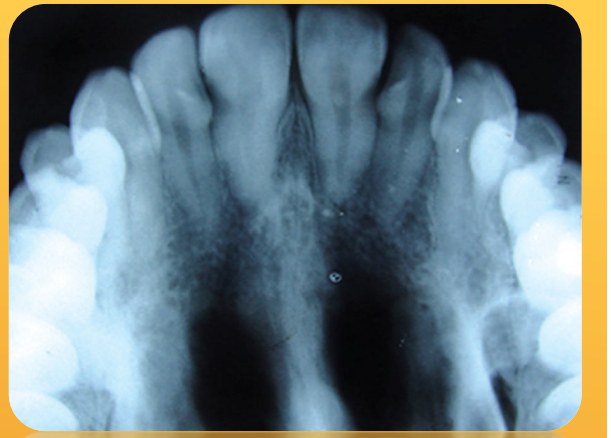
- Improper vertical angulations may lead to shortening or lengthening of image.
- Interdental bone less will be poorly demonstrated.
- Shadow of zygomatic bone frequently overlies the roots of upper molars.
- Horizontal and vertical angles have to be assessed for every exposure, considerable skill is needed.
- Cone-cut may result if improper positioning of tube is done.
- Incorrect horizontal angulation will result in horizontal overlapping of crowns and roots.
- Crowns of teeth are often distorted, thus preventing detection of proximal caries.

SUPPLEMENTARY INTRAORAL RADIOGRAPHIC TECHNIQUE



Bitewing Radiography

- Developed by Howard Raper in 1925.
- Periapical films are used to record the coronal portions of both maxillary and mandibular teeth in one image
- Size 1 film is used in children and size 2 films are used in adults.
- Used mostly to detect interproximal caries and to check the level of bone.



Occlusal Radiography

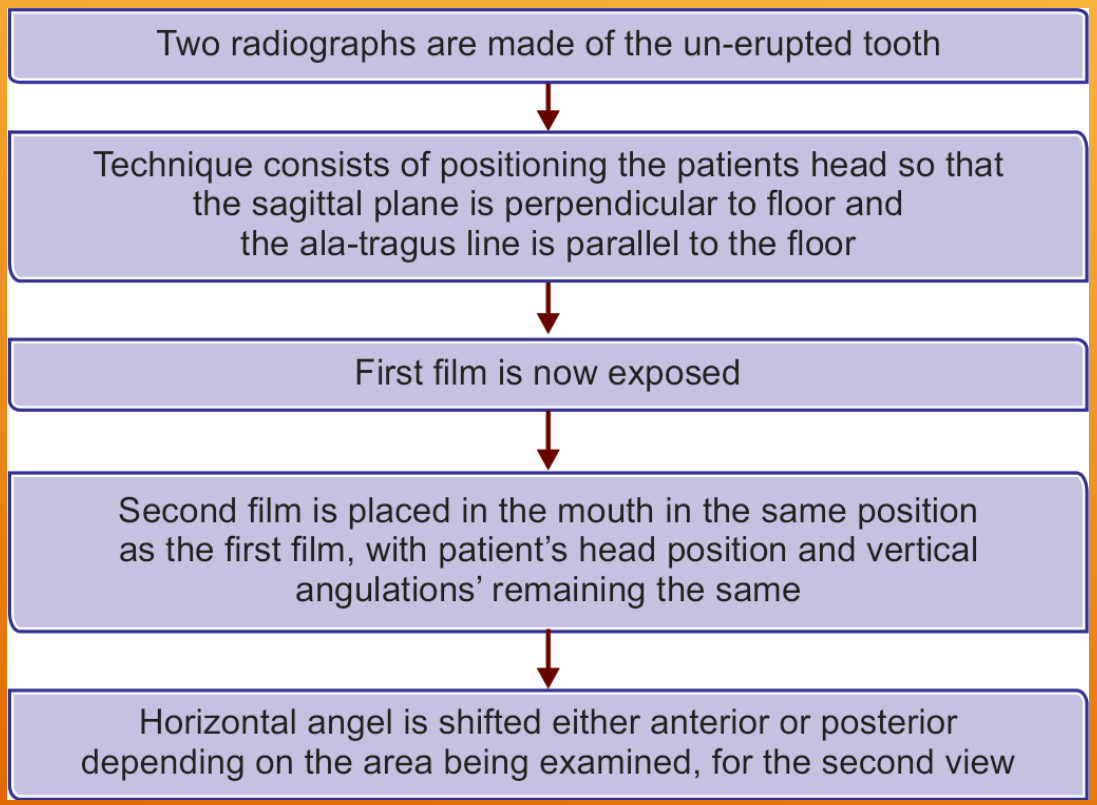
- Used to take the jaw radiographs of maxilla and mandible to detect large lesions, fractures, impactions, supernumerary teeth and to localize foreign bodies.
- The film is partially held in-between teeth and partially supported by patient.
- The vertical angulation for maxilla is +45° and for mandible is – 55°.

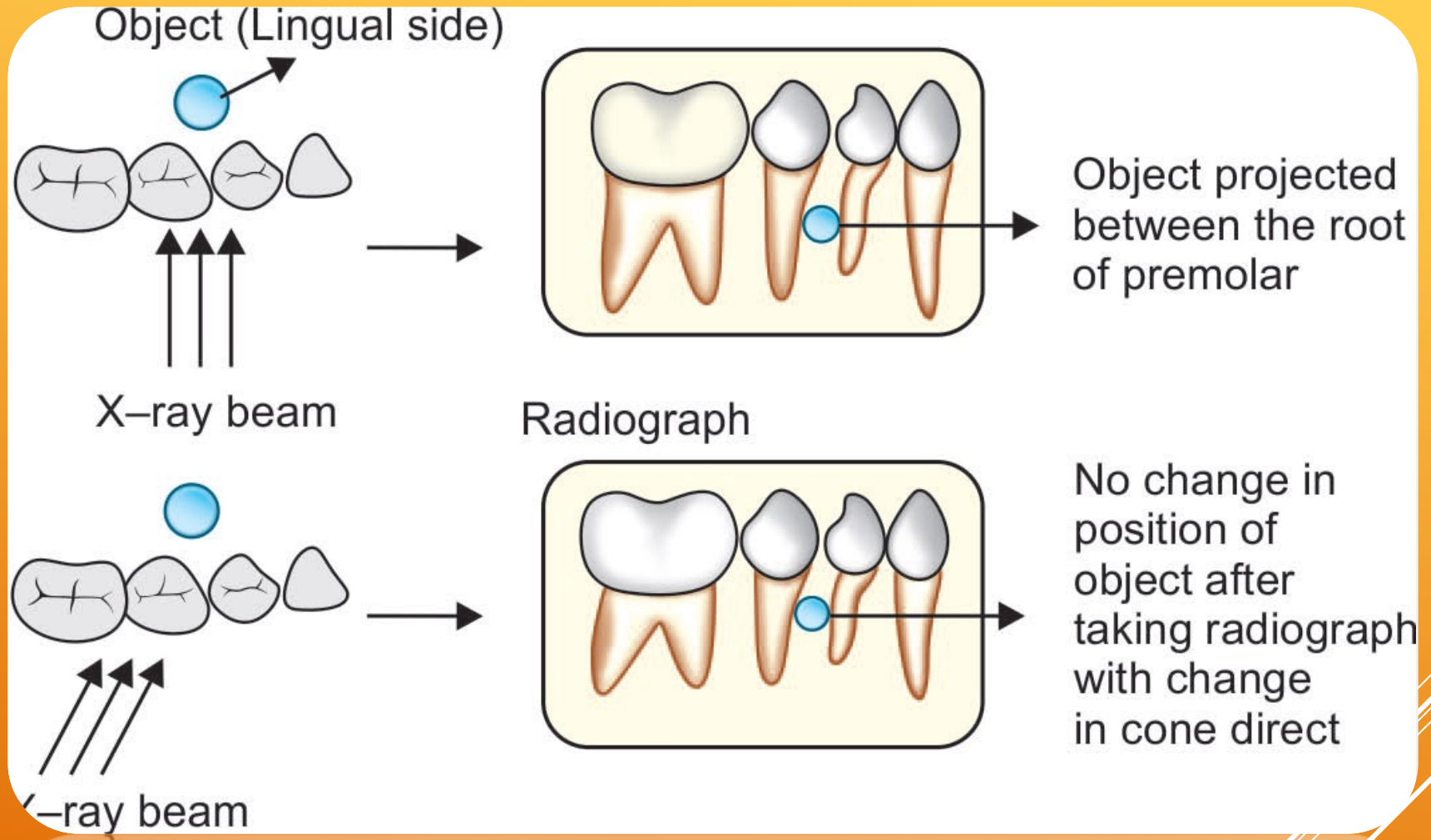
Specialized Intraoral Radiographic Technique

- This technique is used exclusively for children as is called bent film radiographic technique.
- This technique works well with young children, require little skill as patient bites down.
- Used when young patient do not tolerate the placing of a film holder inside their mouths.
- Top portion of the film is bent at right angle and this serves as a bite block to hold the film in place. Patient is instructed to bite the film slowly and radiograph is taken. Care must be taken to straighten the film before processing.
- This can be used both with paralleling cone or bisecting angle technique.
- Size 1 or 2 film should be used.

RADIOGRAPHIC LOCALIZATION PROCEDURE

CLARK'S TECHNIQUE




Object (Lingual side)
X–ray beam
Radiograph
Object projected between the root of premolar
No change in position of object after taking radiograph with change in cone direct
X–ray beam

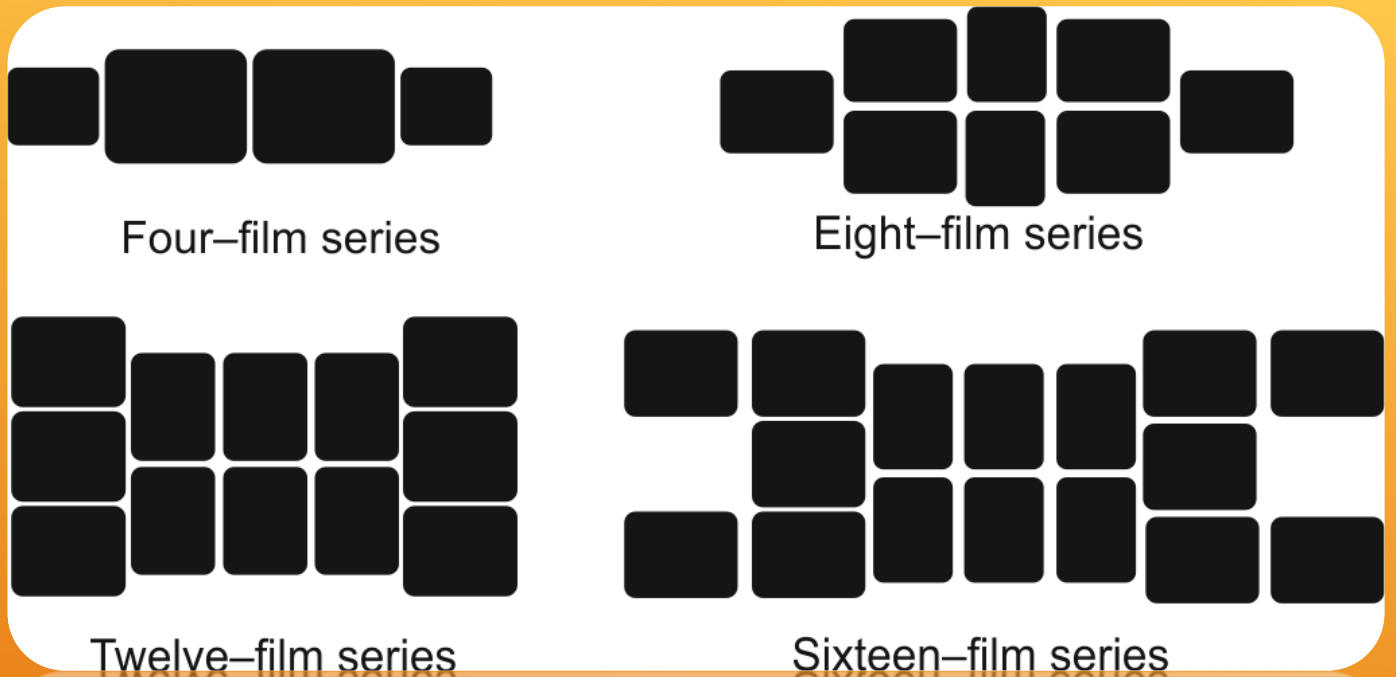
Miller's Technique

- **This is also called right angle technique.**
- **It is used to achieve the same goal as Clark's technique but in case of mandible**

RADIOGRAPHIC PROTOCOL:

- *Radiographic examination/survey:* To accomplish the task of radiographic protocol specific X-rays are needed to be done at each age.
- These X-rays are mostly individualized for each patient and depending upon age and caries may be classified as four, eight, twelve or sixteen film series
- This entire set of X-ray series is called radiographic survey

Age (Yrs)	*Considerations*	*Radiographs*
3–5 Yrs	No apparent abnormalities (Open contacts)	None
	No apparent abnormalities (Closed contacts)	2 posterior bitewing
	Extensive caries	4-film survey
	Deep caries	2 bitewing of size 0, 1 selected periapical radiographs in addition to 4-film su
6–7 Yrs	No apparent abnormalities/Extensive caries	8 film survey/selected periapical X-ray and 8 film survey
8–9 Yrs	No apparent abnormalities/Extensive caries	12 film survey
10–12 Yrs	No apparent abnormalities/Extensive caries	12 or 16-film survey


Four–film series
Eight–film series
Twelve–film series
Sixteen–film series

Survey	*Radiographs*
Four film series	Maxillary and mandibular anterior occlusal and two posterior bitewing radiographs
Eight film series	Maxillary and mandibular anterior occlusal (or periapicals), right and left maxillary posterior occlusal (or periapical), ri and left mandibular posterior periapicals and two posterior bitewing radiographs
Twelve film series	Two primary molar-premolar periapical radiographs, four canine periapical radiographs, two incisor periapical radiogr two posterior bitewing radiographs
Sixteen film series	12 film survey, four permanent molar radiographs

PANORAMIC RADIOGRAPHY:

- It was developed by Dr H Numata (1933).
- This is also called orthopantomography/maxillomandibular radiography/pantomography/rotational tomography.
- This uses a mechanism by which the X-ray film and the source of the X-rays move simultaneously in opposite direction at the same speed

Indications

- Condylar fracture.
- Traumatic cysts.
- Evaluation of tooth development (mixed dentition).
- Developmental anomalies.
- Disabled child

Advantages

- Broad anatomic region imaged.
- Relatively low radiation dose.
- Convenience, speed and ease.
- Useful in patients who are unable to open mouth

Disadvantages

- Lack of image detail for diagnosis of early carious lesion.
- Cost of X-ray machine
- Overlaps images of teeth
- Staying completely immobile for 15 seconds may not be possible for very young children

- **Uses**

- Evaluation of gross carious status.
- Assessment of advance bone heights.
- Extensive cystic and tumor cases.
- Assessment of mixed dentition.
- Overall assessment of bone pattern.
- Fractures (trauma).
- Preliminary assessment of maxillary sinus diseases.
- General assessments of condyles morphology.

. General assessments of condyles morphology.

• Pre- and postoperative evaluation of oral surgical procedures and orthodontic treatment.

• Changes in alveolar bone due to systemic diseases like leukemias, Pagets disease.

• Evaluation of 3rd molars.

• To assess lesions in edentulous jaws.

• To assess the radiologic assessment of implant site.

• Patient who has gagging sensation to intraoral films.

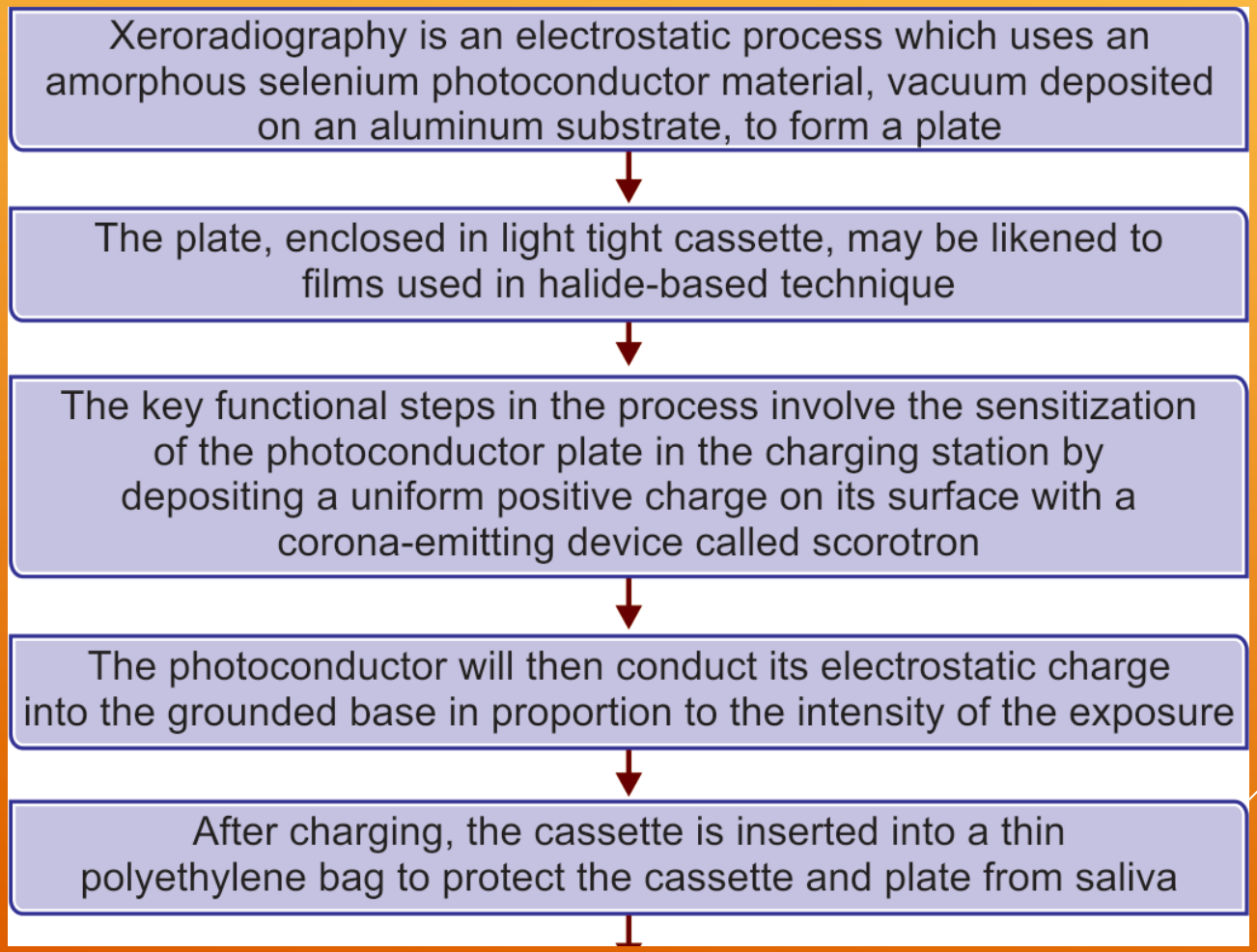
• Ankylosis of TMJ.

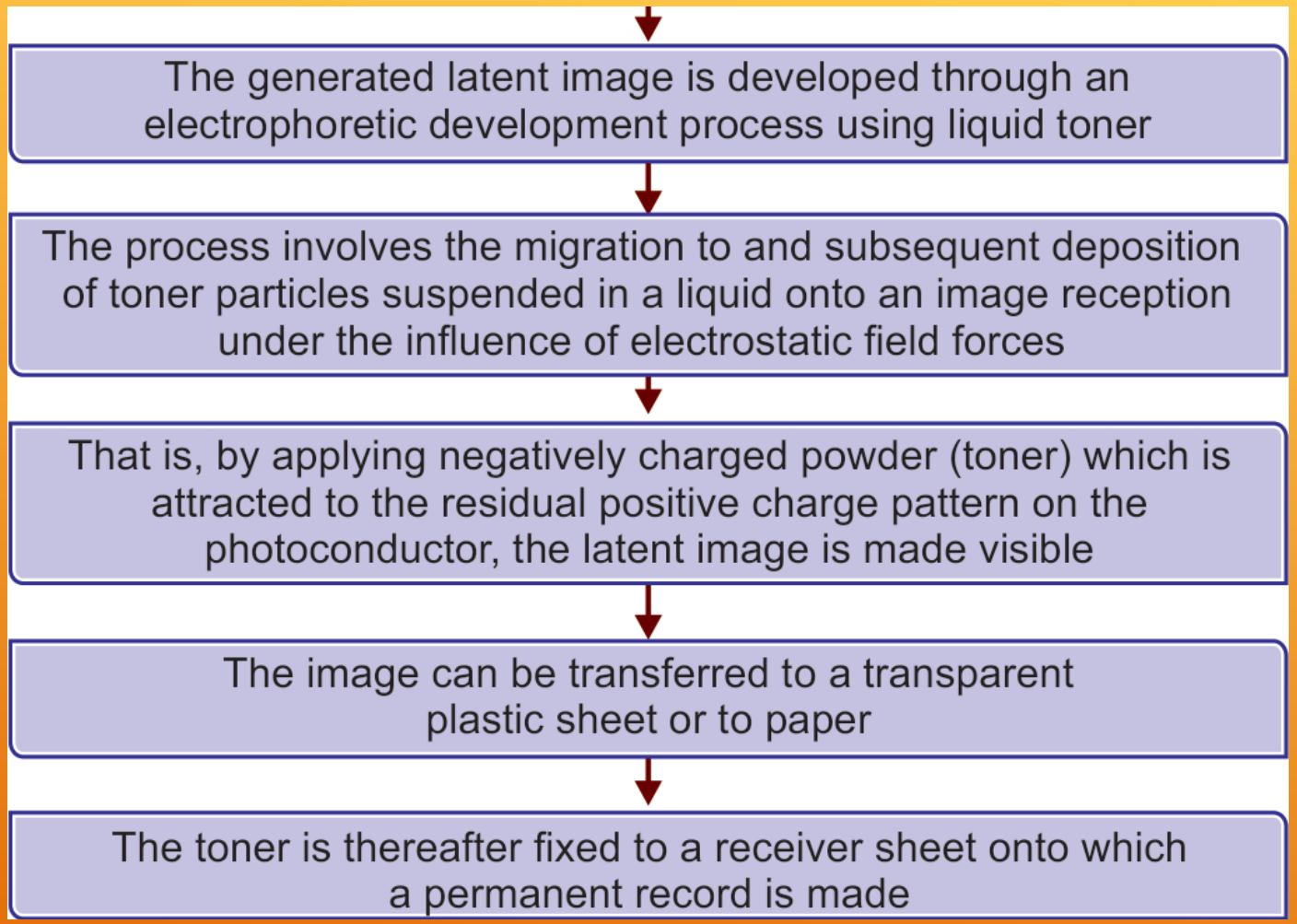
• Patient's with restricted mouth opening.

• Evaluation of tooth development

SPECIALIZED RADIOGRAPHY:

XERORADIOGRAPHY




The generated latent image is developed through an electrophoretic development process using liquid toner
The process involves the migration to and subsequent deposition of toner particles suspended in a liquid onto an image reception under the influence of electrostatic field forces
That is, by applying negatively charged powder (toner) which is attracted to the residual positive charge pattern on the photoconductor, the latent image is made visible
The image can be transferred to a transparent plastic sheet or to paper
The toner is thereafter fixed to a receiver sheet onto which a permanent record is made

ADVANTAGES:

- *Elimination of accidental film exposure*
- *High resolution*
- *Simultaneous evaluation of multiple tissues*
- *Ease of reviewing*
- *Better ease and speed of production*
- *Economic benefit*
- *Reduced exposure to radiation*
- *Wide applications.*

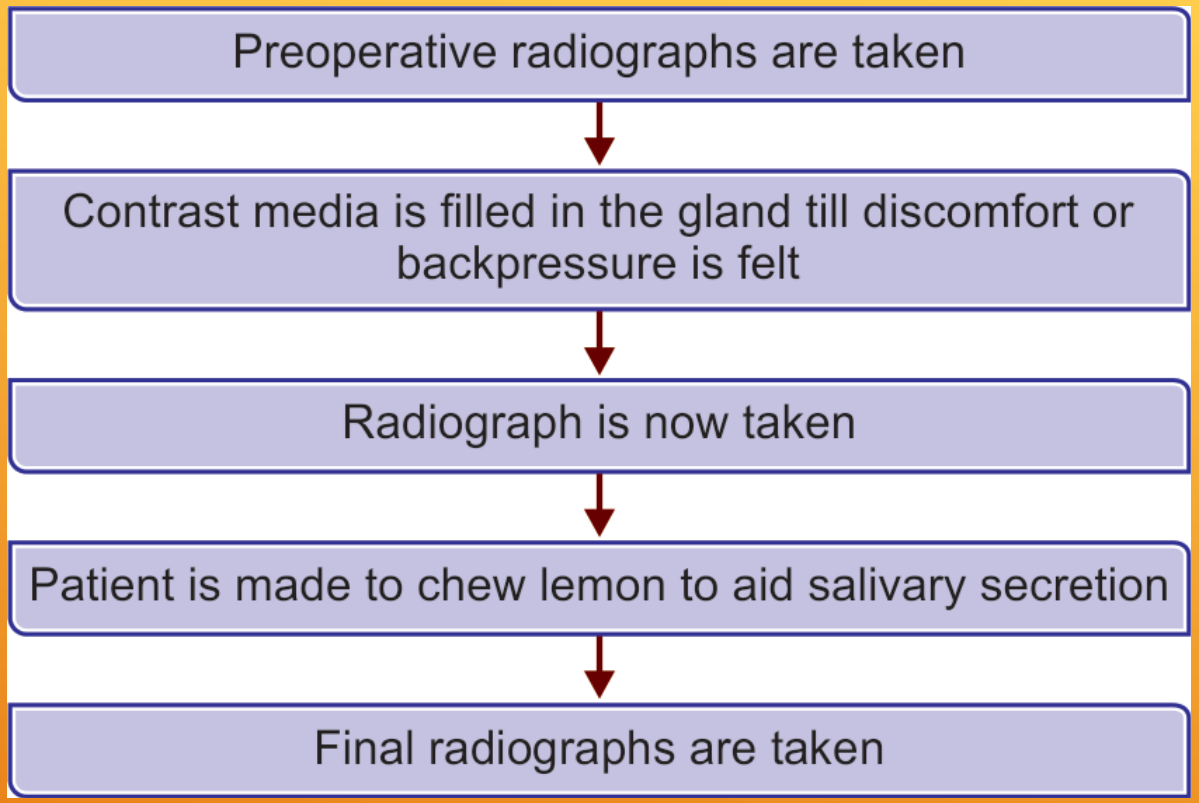
Disadvantages

- The electrostatic charges in xeroradiographic process stand the risk of being lost in confined humid oral environment
- Technical difficulties
- Fragile selenium coat
- Transient image retention
- Slower speed.

SIALOGPAPHY:

It is the radiographic examination of the salivary glands.

It usually involves the injection of a small amount of contrast medium into the salivary duct of a single gland, followed by routine X-ray projections


Preoperative radiographs are taken
Contrast media is filled in the gland till discomfort or backpressure is felt
Radiograph is now taken
Patient is made to chew lemon to aid salivary secretion
Final radiographs are taken

Indications

- In the evaluation of the functional integrity of the salivary glands
- In case of obstructions
- To evaluate the ductal pattern
- In case of facial swellings, to rule out salivary gland pathology
- In case of intraglandular neoplasms.

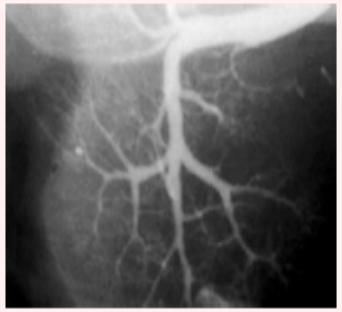
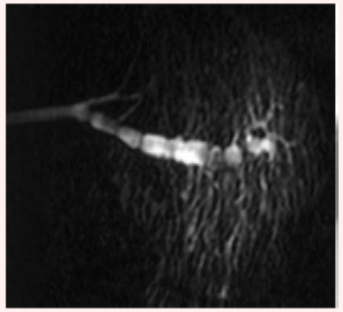
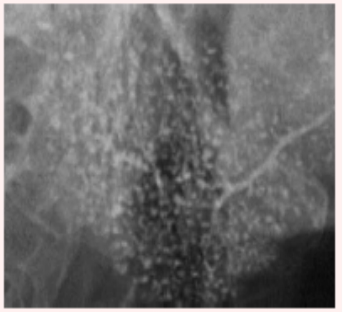
Contraindications

- Persons who have allergy to iodine and/or contrast medium
- Cases where there is acute infection
- Patients with thyroid function tests
- When calculi are located in anterior part of the salivary gland duct.

KEY POINTS:

- *Usually the radiographs taken are lateral oblique views of the face*
- *Used for diagnosis of foreign body, calculus or tumor in salivary gland*
- *Water soluble contrast media include Conray 480, Hypaque, Renagraffin*
- *Fat soluble medias are ethiodol and lipiodol.*

Variable clinical pictures via Sialography

Normal parotid gland	*Normal submandibular gland*	*Salivary calculi appearance*	*Sialadenitis*	*Sjögren's syndrome*
Branching structures like tree (Fig. 8.17)	Bush like appearance (Fig. 8.18)	Filling defect (Fig. 8.19)	Dots of media between branching of gland (Fig. 8.20)	Huge dots of media between branching of gland like cherry blossom appearance (Fig. 8.21)
				

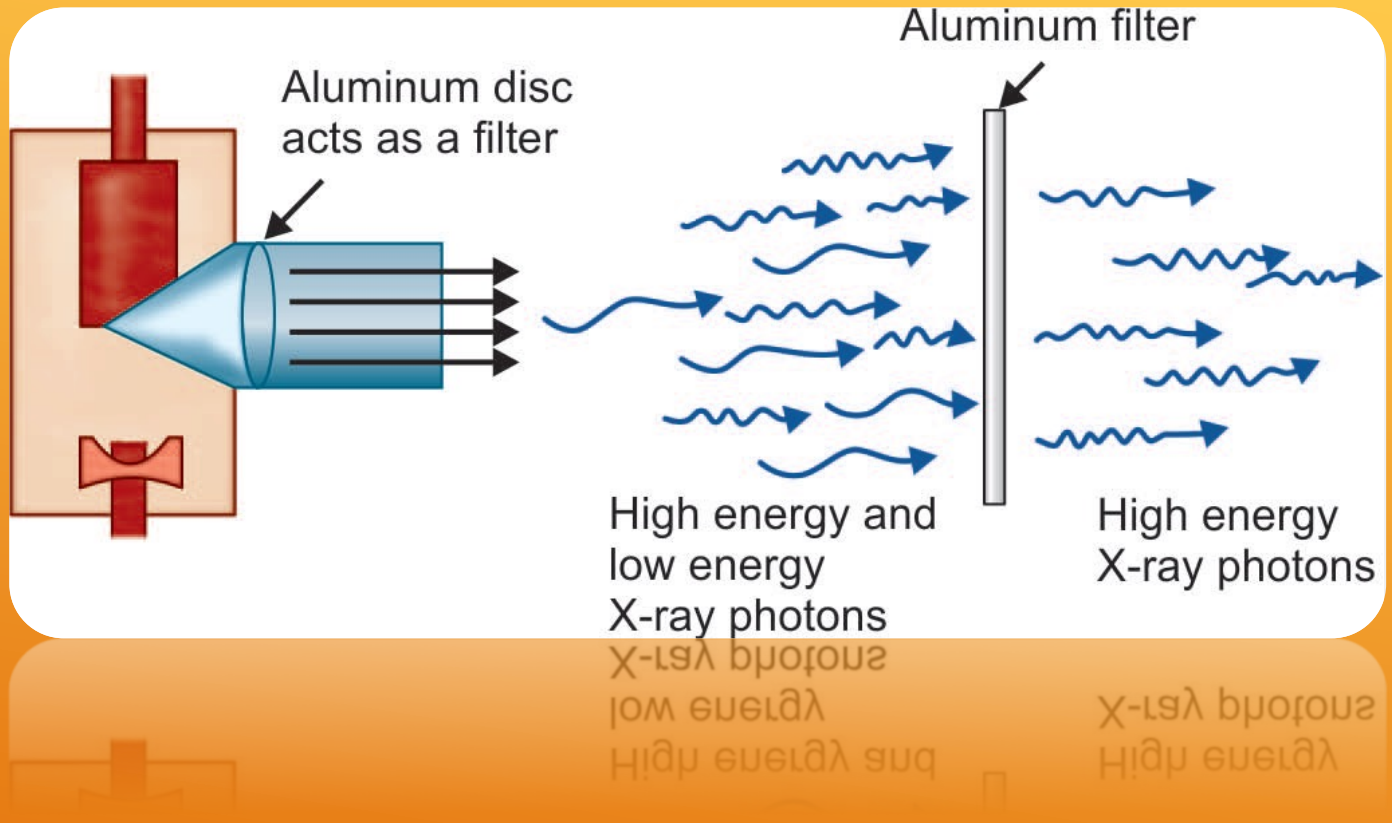
HAND WRIST RADIOGRAPH

- ***The hand-wrist region is made up of numerous small bones which show a predictable and scheduled pattern of appearance, ossification and union from birth to maturity. Thus by comparing a patients' radiograph with the standards that represent different skeletal ages, we find out the skeletal maturation status of that individual.***

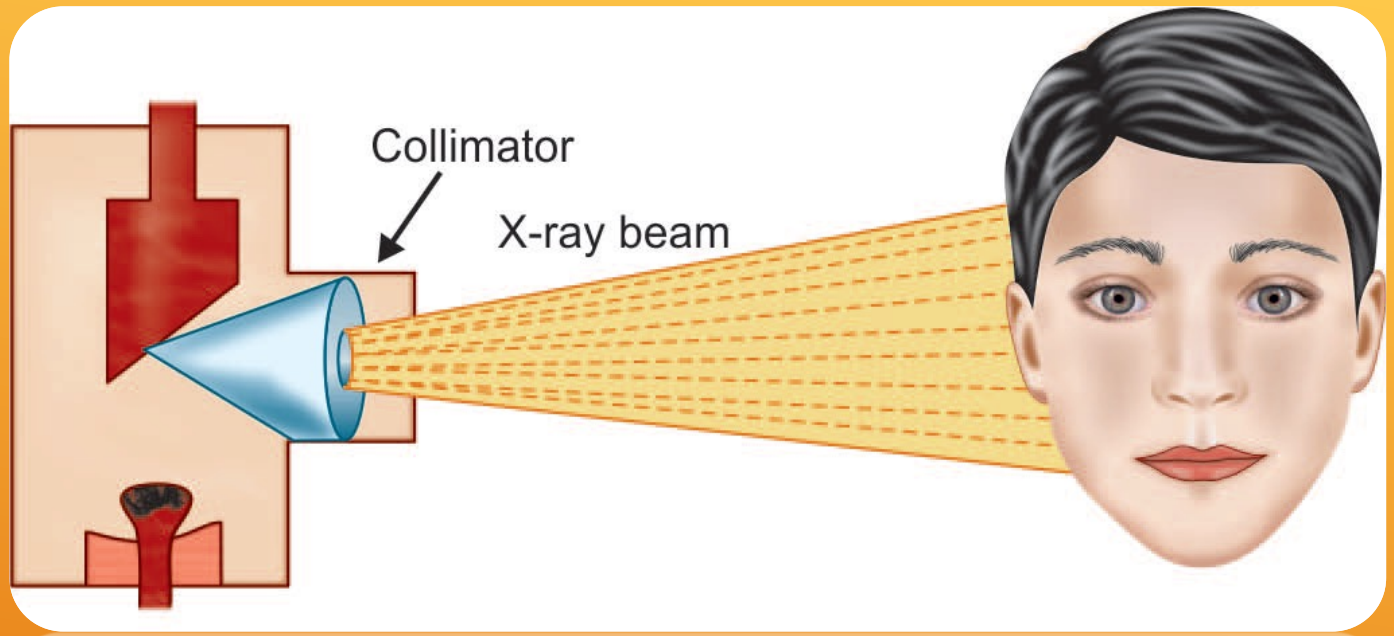
CEPHALOMETRICS

- ***It is the study of the dental and skeletal relationships in the head and is used by dentists, as a treatment planning tool to evaluate facial growth abnormalities prior to treatment, in the middle of treatment to evaluate progress or at the conclusion of treatment plan***

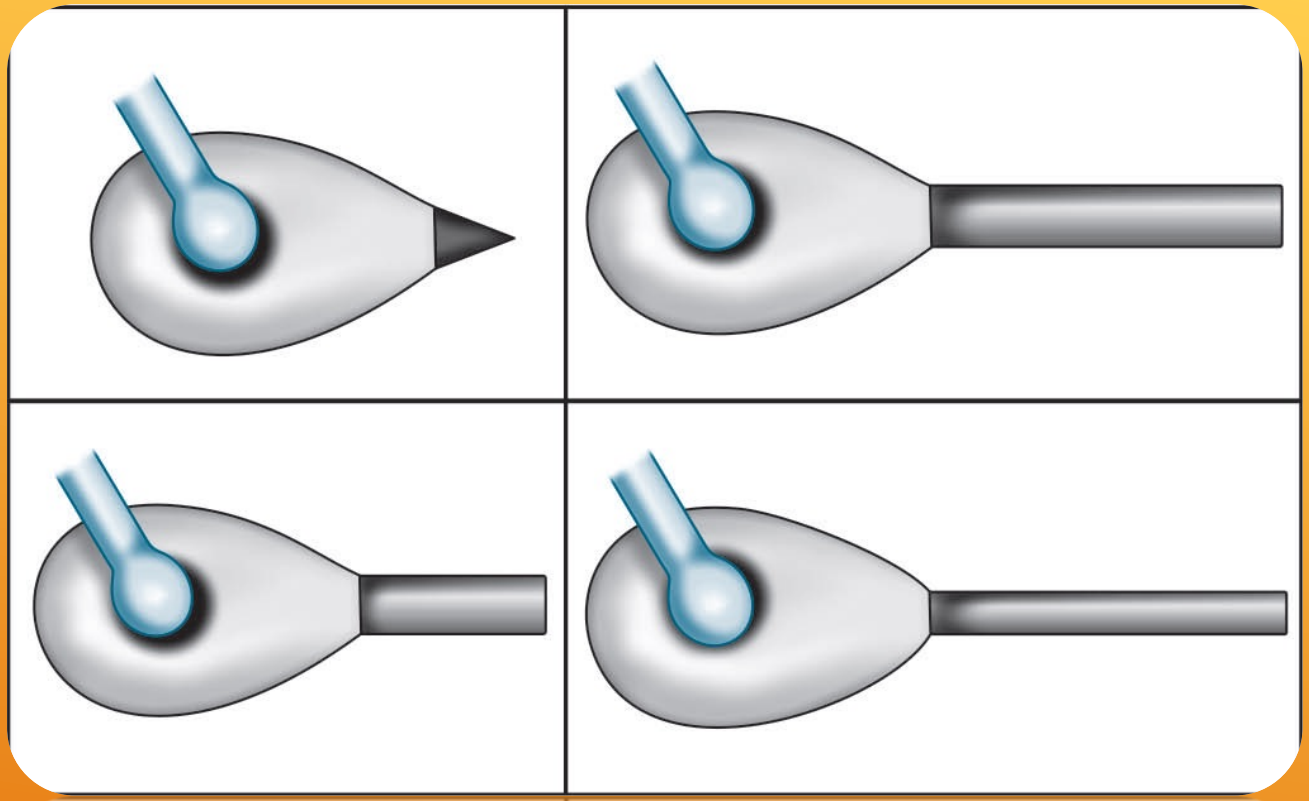
- RADIATION PROTECTION:
- *Prescribing needed dental radiographs*
- *Proper equipment*
- *Aluminum filtration*
- *Lead collimation*
- *Position indicating device/cone (PID)*
- *Thyroid collar*
- *Lead apron*
- *Fast film*
- *Film holding devices*
- *Proper film handling*
- *Correct film processing procedures*



ALUMINIUM FILTERS



COLLIMATION



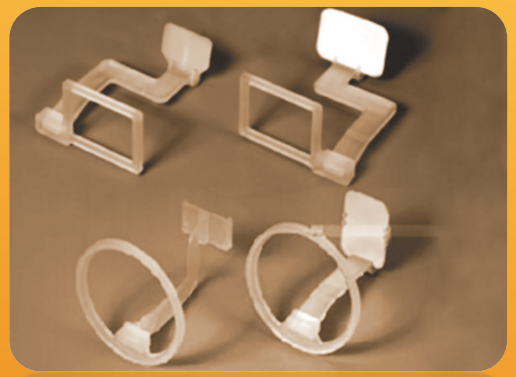
POSITION INDICATING DEVICE

THYROID COLLARS

LEAD APRON

OPERATOR PROTECTION GUIDELINES:

- Dental radiographer must avoid the primary beam
- Stay 6 feet away from X-ray tube during X-ray procedure
- Use protective barriers
- To avoid the primary beam the dental radiographer must be positioned at 90 to 135° angle to the beam
- The dental radiographer must never hold a film in place for a patient during X-ray exposure



- Never hold a tube head during X-ray exposure
- Should stand behind a protective barrier like lead screens
- X-ray machine should be monitored for leakage radiation
- Amount of X-radiation that reaches the body of the dental radiographer can be monitored by use of personnel monitoring device known as film badge

RADIOGRAPHIC INFECTION CONTROL:

- Training of staff in infection control procedures.
- All clinical staff should be vaccinated.
- Open wounds on hands should be covered with waterproof dressings.
- Latex gloves should be worn for all radiographic procedures but eye safety protection and masks are not usually necessary.
- Gloved hands should be washed under running water.
- Before and after X-raying every patient, using a disinfectant such as povidone iodine 7.5 percent, surgical scrub (betadine) or chlorhexidine 4 percent (Hydrex).

- All required film packets and holders should be placed on disposable trays to avoid contamination of work surfaces.
- To prevent salivary contamination of film packets, they can be placed in small barrier envelopes before use. After use, the film packets can be emptied out of the barriers envelope into a clean surface and then handled safely.
- Film packets must only be introduced into daylight loading processors using clean hands or washed gloves.
- All film holders/bite blocks/bite pegs should be rinsed after use and then autoclaved or discarded, if disposable.

BEHAVIORAL CONSIDERATIONS IN PEDODONTIC RADIOGRAPHY

Radiographic recommendations for children with disabilities

- ***Only radiographic investigations appropriate to the limitations imposed by the patient's age, cooperation or disability, should be attempted.***
- ***Select intraoral films of appropriate size, modifying standard techniques as necessary.***
- ***Utilize assistants to help hold the film.***
- ***. Avoid dental panoramic radiography because the patient will have to sit still for 18 seconds.***
- ***Oblique lateral radiograph should be regarded as the extraoral view of choice.***
- ***Use of paralleling technique, if possible for periapical radiography***

Thank you…….