1. Pain management and pharmacology
2. Radiography

Dr. Lama Hammoud

Local Anesthesia:

Local Anesthesia is given while the is fully conscious. It blocks nerve endings from transporting pain messages to the brain. It can be differentiated as:

- **Topical analgesia (in a specific place): application of topical anesthetics to places about to receive injections.**
- **Local anesthesia (limited to one place): loss of sensation in a selected area.**

Methods of administration of local anesthesia:

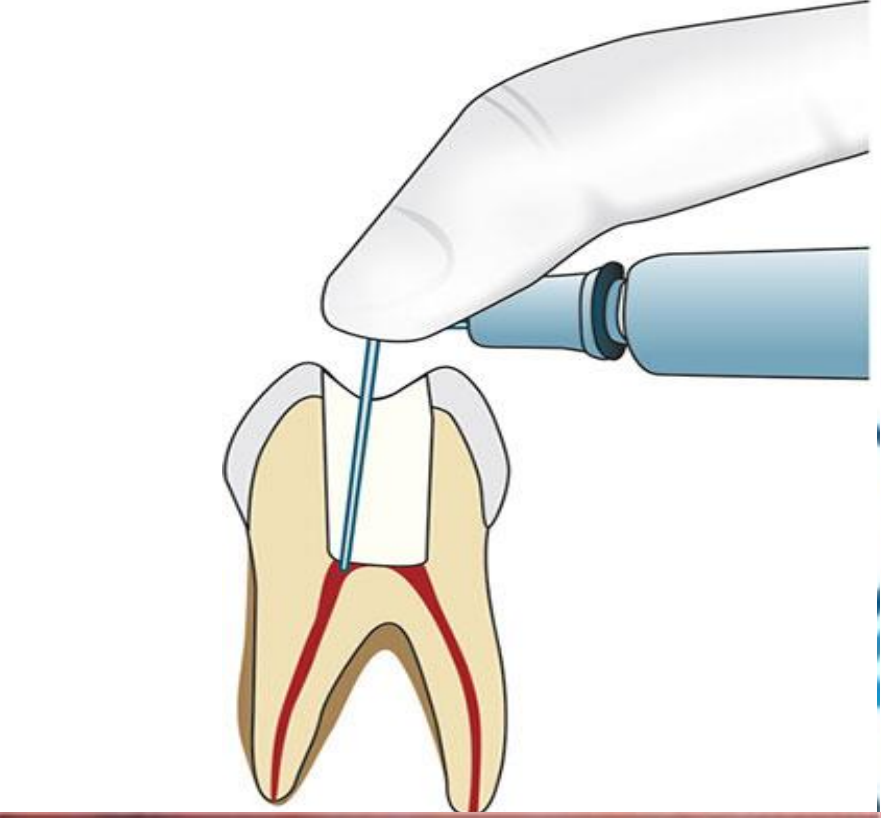
Infiltration anesthesia: direct into the tissue near the nerve ending of the operative site.

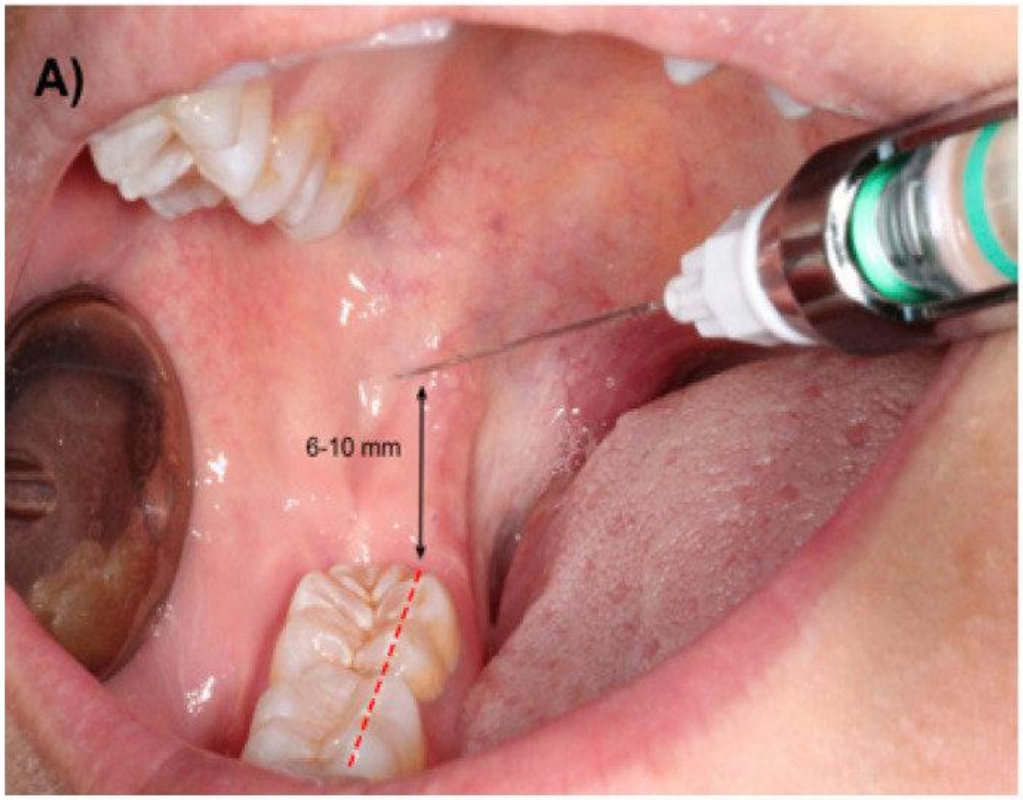
Block anesthesia: injection into a nerve bundle to enable anesthesia to a wider area.

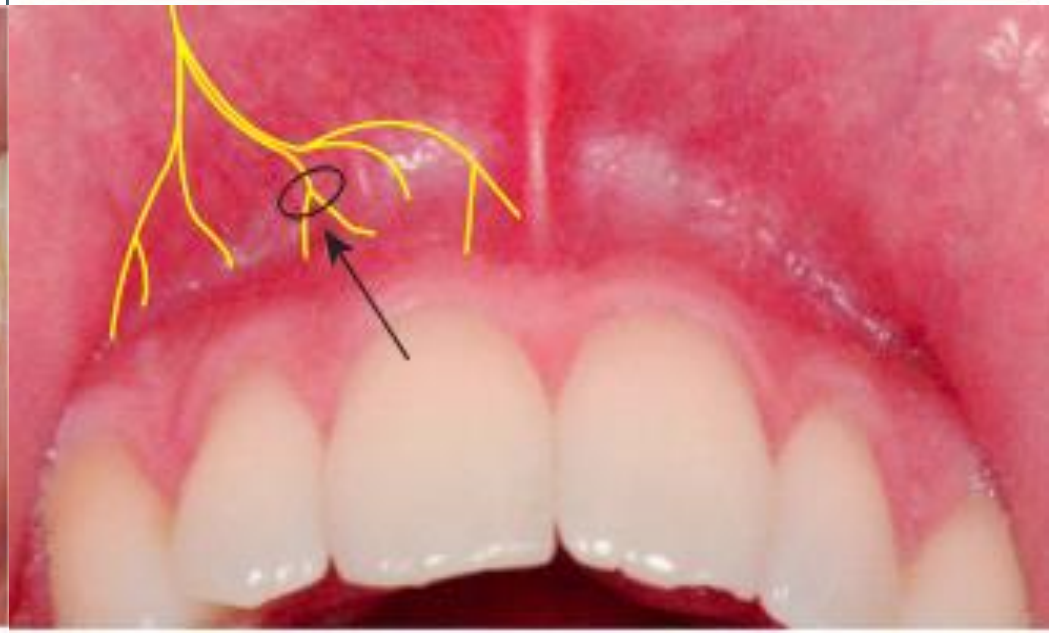
Intraosseous: directly into the spongy bone for single tooth or multiple teeth in the same quadrant. It may be used for a patient who dose not desire a fat lip or tongue.

Intrapulpal: injection directly into the pulp chamber using a long needle.

Intraligamentory: also called periodontal ligament injection ; done mainly in the mandibular arch




A)
6-10 mm



Equipment used for local anesthesia:

Anesthesia syringe : two types plain and aspiration. The aspirating syringe is the syringe of choice because it used to determine if the needle penetration has been placed in the proper site.

Needle: size gauges 25,27 and 30; the higher the number, the thinner the needle. the length of needle can vary some by manufacturer, but usually, a long needle 32 mm(1.5 inches) and the short is about 20 mm (1 inch). The bevel of the needle is the slant at the entry tip, and the lumen of the needle is the hole in the needle`s shaft for solution to pass through.

Carpule: also called cartridge containing the anesthesia solution to be placed by the syringe

Anesthesia: either of two types ;

Ester: alcohol –based solution, such as procaine.

Amid: water –based solution, such as lidocaine , prilocaine, articaine.

A **vasoconstrictor** is a chemical (epinephrine) that is added to the anesthesia solution to constrict blood vessels which allows less bleeding and longer anesthesia through **hemostasis**.

Complications with local anesthesia:

Allergy: a reaction to the anesthesia.

Anaphylactic shock: a reaction to the medication, delivery or amount of anesthesia.

Hematoma: blood swelling or bruise.

Trismus: grating or tonic contracting of the jaw or muscle rigidity.

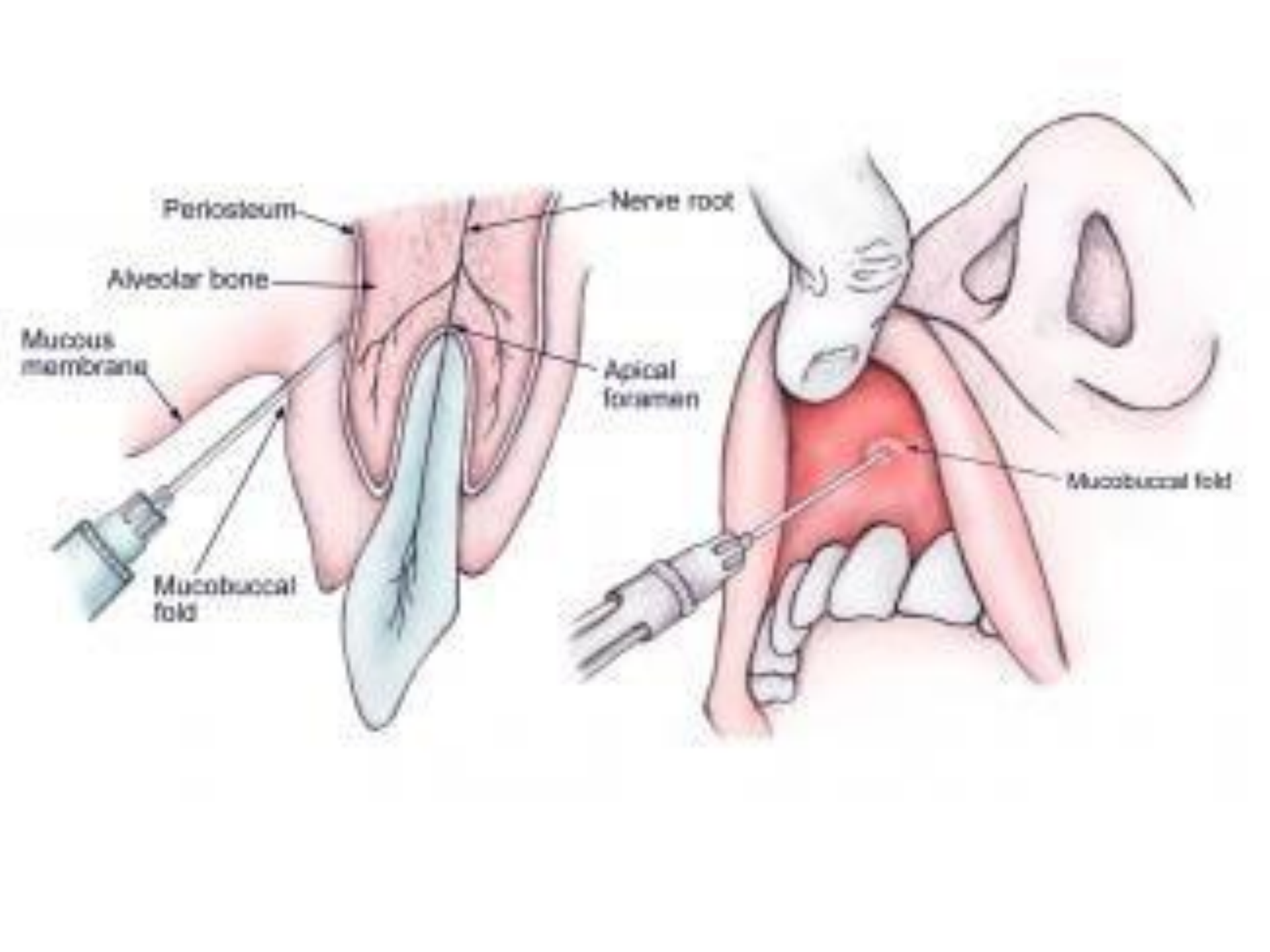
Parasthesia: abnormal feeling occurring after anesthesia .

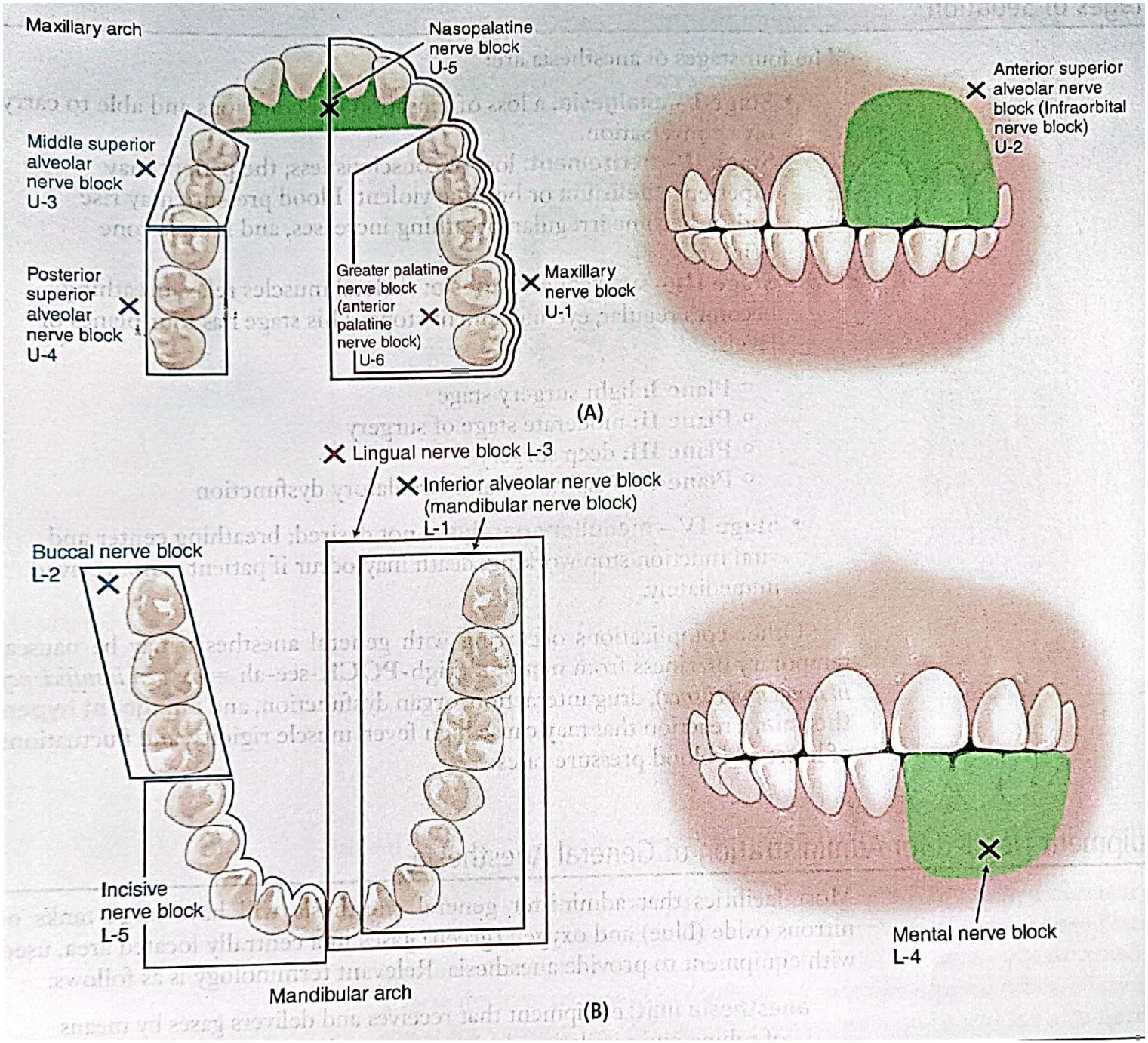
Common local anesthesia:

- Lidocaine
- Benzocaine
- Tetracaine
- Procaine propoxecaine
- Mepivacaine
- Bupivacaine
- Prilocaine

Injection sites for local anesthesia:

Teeth or Tissue to receive local anesthesia	nerve branch involved	injection site location
individual teeth	infliltraion	apex of tooth near mucobuccal fold
maxillary quadrant	maxillary nerve block	over the distal root of the maxillary molar U-1
centrals ,laterals, and cannies	anterior superior alveolar	in mucobuccal fold between the cannine and premolar U-2
premolars and mesial root of the maxillary first molar	Middle superior alveolar	in mucobuccal at the apex of the of the second premolar U-3
remaining maxillary molars and buccal molar tissues.	posterior superior alveolar	mucobuccal fold the at the apex of the second molar U-4
anterior block from canine to caninne	nasopalatine block	on palate near the incisive papilla U-5
hard palate	greater anterior palatine	palatine near the second molar and greater palatine Foramen U-6


Periosteum
Nerve root
Alveolar bone
Mucous membrane
Apical foramen
Mucobuccal fold
Mucobuccal fold



Mandibular arch injections

Teeth or Tissue to receive local anesthesia	nerve branch involved	injection site location
individual teeth	infiltration area	near apex of individual teeth
mandibular quadrant	inferior alveolar nerve	posterior to the retromolar pad inside the mandibular ramus L-1
molar buccal tissues	buccal nerve block	on the buccal side distal to most posterior tooth L-2
lingual tissue, side of tongue, molars to mid-quadrant	lingual nerve block	mandibular posterior lingula area near mandibular ramus L-3
premolars, canine in quadrant	mental nerve block	between apices of mandibular premolars in mucobuccal fold L-4
premolars, canines, laterals, centrals, lips, mucous membranes	incisive nerve block	anterior to the mental foramen in the mucobuccal fold L-5

Pharmacology and the science of drugs:

The use of drugs and medicines in operative treatment and the care of the patient require knowledge of drug agents and body reactions.

The study of drugs and their effects is termed **pharmacology** .

Drug interactions with body functions:

Although drugs enter the body by various methods. Effectiveness of drug depends on bodily processes involved in taking in (absorbing),distributing, using (metabolizing), and removing drugs from the body.

Absorption: process in which fluids are transferred from administration site by the circulating body fluids.

Distribution: process of dividing and delivering the absorbed drug to the desired site.

Metabolism: process of physical and chemical changes that enable the body to use the drug.

Excretion: process of elimination of waste products from the body.

Effects of drugs on the body:

Drugs produce a variety of effects on the body, defined as follows:

Adverse effect: response to drug that is not desired because it is too intense, also called a side effect.

Addiction: compulsive, uncontrollable dependence on a drug to the extent that cessation causes severe physiological and emotional reactions.

Allergy: specific body reaction to a drug, also termed *hypersensitivity*; can be result of an antibody harbored in the patient`s body.

Anaphylaxis: a life-threatening allergic reaction to a drug that may produce an immediate or a delayed body reaction; called anaphylactic shock.

antagonism: opposite or contrary action of drug.

dependence: physical (chemical) or psychological (desire) need to use a drug despite related problems that may accompany it.

drug interaction: effect resulting from the combination of two or more drugs at one time.

idiosyncrasy: unusual or abnormal drug response that may be genetic in nature or a result of an immune disorder.

intolerance: inability of the body to endure a drug or the incapacity of a drug to achieve a desired effect because of long- term use.

overdose: effect from excessive drug dosage.

side effect: reaction from a drug that is not the desired treatment outcome.

synergism: harmonious action of two drugs to produce a desired effect.

teratogenic: drug effects on a fetus , for example, tetracycline affecting tooth color.

Drug forms :

Aerosol spray.	Pill
Capsule.	Solution
Cream	Spirit
Elixir	Suppository
Emulsion	Suspension
Intradermal implant	Syrup
Lozenge or troche	Tablet
Micropump	Tincture
Ointment	Transdermal patch

Routes for drug administration:

The routes and method of drug administration affects the action of a medication. The onset , or start , of the drug effect and the length of its effect- its duration- depends on its method of entry into the body.

Intravenous (IV) is the quickest method.

The potency and the efficacy of a drug also are affected by the route of administration.

Drugs may be taken in the gastrointestinal tract (GI system) by the oral or rectal route. These methods are termed enteral , and other method, such as injection, and are called parenteral.

Abbreviation	Route of Administration	Method of Administration
PO	Oral route	Swallowing, ingesting medication
IV	Intravenous	Injection within a blood vessels
IM	Intramuscular	Injection into a muscle
SC,SQ	Subcutaneous	Injection into subcutaneous tissue
ID	Intradermal	Injection into the skin epiderms
IH	Inhalation	Breathing in of drugs, NO2,gas
SUPPOS	Rectal	Insertion into rectum, suppository
IT	Intrathecal	Within the spinal canal
	Intraperitoneal	Within the peritoneal cavity
	Topical	on the surface
	Sublingual, buccal	under the tongue or side of cheek
	Transdermal patch	applied to skin
	Drug implant	Surgical implant (stent) under skin

Drug prescription content:

The standard drug prescription must contain the following:

Heading : Name, address, and telephone number of the prescriber

Name, address, and telephone number of the patient

Date

Body: Rx symbol (abbreviation of Latin recipere, take thou that gave

the list of the medication

Name, dose , size, or concentration of drug

Amount to be dispensed

Instructions to patient

Closing: Signature of prescriber

DEA number (if required)

Refill instructions

The prescription blank is further divided into four separate parts:

- **Superscription**: Name, Address, age of patient, date, and Rx symbol
- **Inscription**: Drug name, dose form, amount of drug.
- **Subscription**: Directions to the pharmacist.
- **Transcription or signature**: Direction to the patient

Superscription Lester Payne, D.D.S.
1000 Central Avenue
Anytown, US 12345
1-867-555-5667

For _____ Date _____

Address _____ Age _____

Rx

Inscription	Name and amount of drug =	Drug X tabs xx mg.
Subscription	Directions to the pharmacist =	Dispense xx tabs.
Transcription	Directions to the patient =	sig: 1 tab. as needed

_____ D.D.S.

D.E.A. #12345

Classification and types of drug agents:

Anti- infective Drugs:

An anti-infective drug is an agent that combats or destroys infections. These substances include antibiotic, antimicrobial, antifungal, and antiviral agents.

There are two classes of anti-infectives, prophylactic and therapeutic.

The spectrum is the range of the drug`s activity, and resistance is the ability of microorganisms to be unaffected by the drug. Both characteristics help to determine the choice of drug.

The major anti-infective drugs are:

Penicillin: family of antibiotic drugs, such as penicillin G and V groups.

Ampicillin

Amoxicillin

Erythromycin

Tetracycline

Cephalosporin

Topical antibiotic: applied to the skin at infection site.

Antiviral drugs: agents that destroy or suppress the growth of viruses.

Antifungal drugs: agents that destroy or hamper the growth or multiplication of fungi.

Cardiovascular drugs:

Cardiovascular drugs are agents employed for treatment of a variety of disease of the heart and blood vessel.

Anticoagulants: delay or prevention of blood clots, coagulation.

Antihyperlipids: decrease or prevent high blood plasma lipid, cholesterol.

Antihypertensives: lower or decrease high tension.

Antihypertensive with diuretic: drugs to increase secretion of urine.

Angina pectoris: (condition of pain or pressure around the heart) treated with nitroglycerin, amyl nitrate.

Arrhythmia: absence of rhythm

Allergy Drugs:

Drugs used to treat allergies and other maladies related to the immune system are classified as:

Adrenocorticosteroids: drugs to treat inflamed condition, allergies, and emergencies.

Antihistamines: drug that treat counter acts that effects of histamine.

Anti-Inflammatory Agents:

Anti-Inflammatory drug agents are used to relieve inflammation from arthritis and inflammatory conditions.

Antidepressant Agents:

Antidepressant drugs, used to treat depression, include SSRI(Selective Serotonin Reuptake Inhibitors).

Anticonvulsant Agents:

Drugs used to control convulsions and seizures.

Definition and Production of X-Rays:

X-rays are radiant energy waves that are produced, charged, and emitted from a common center in the dental radiation tube. These highly active, penetrating electromagnetic waves are tiny energy bundles or waves of photons with extremely short wavelengths that are used to penetrate matter and expose photographic film surfaces.

When first discovered by Wilhelm Conrad Roentgen in 1895, they were termed X-rays. The resulting film image is called an X-ray or radiograph.

How X-Rays Are Generated

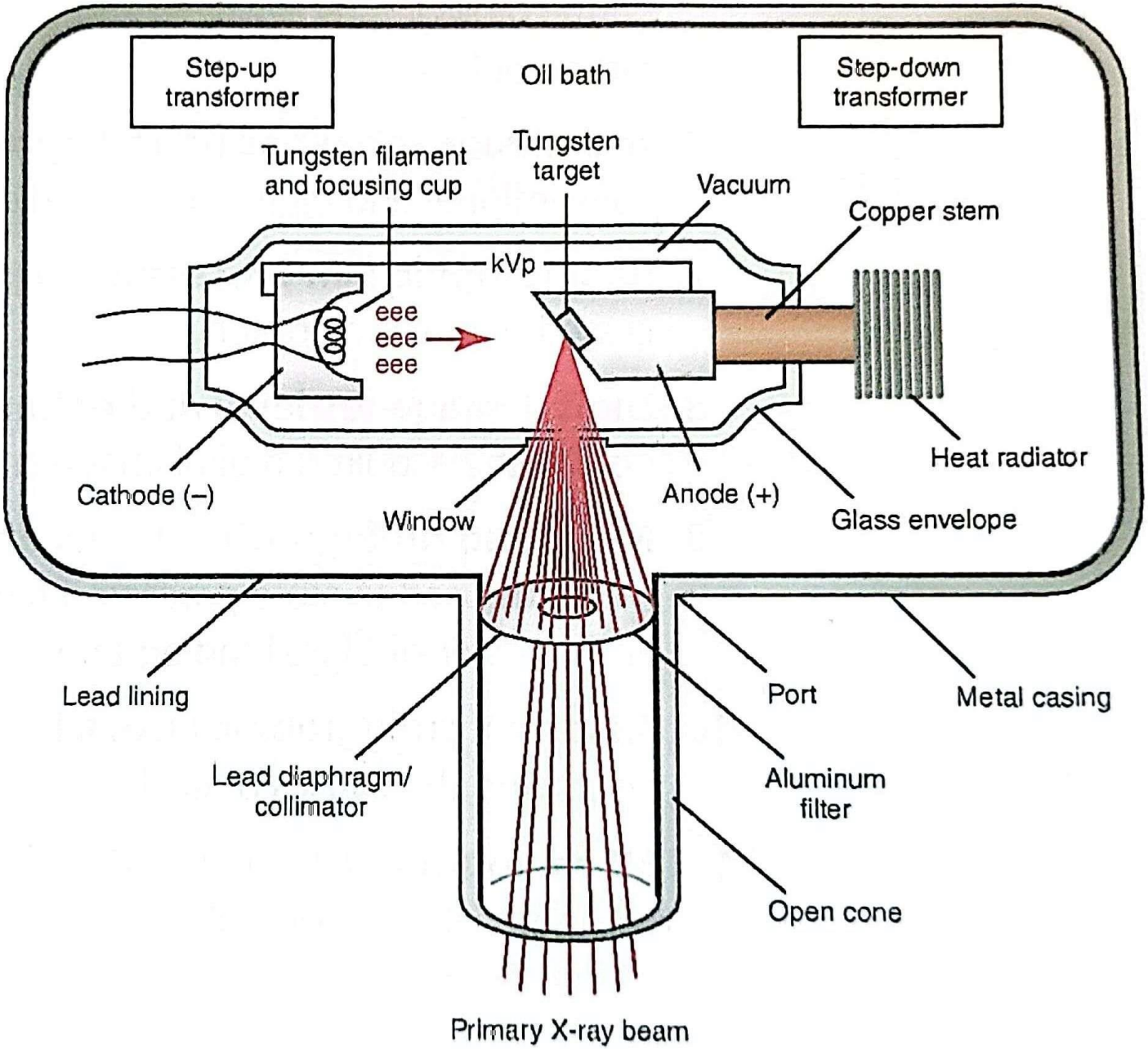
The X-ray tube, also known as a vacuum tube, produces X-rays.

The vacuum tube contains these seven elements of note:

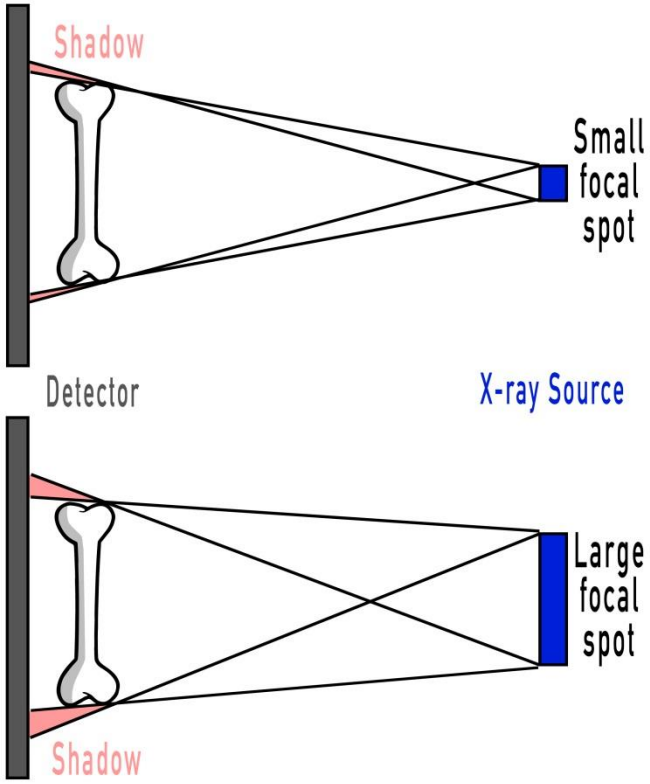
Cathode: (negative pole)electrode in the vacuum tube that serves as the electron source.

Filament: (fine thread) tungsten coil in the cathode focusing cup that generates the electrons.

Anode: (positive pole)the target for the electron barrage to convert the electron force into photons.



Focal spot: target area where rays are projected to make the primary beam, or *central* beam; the smaller focal spot produces a better image.

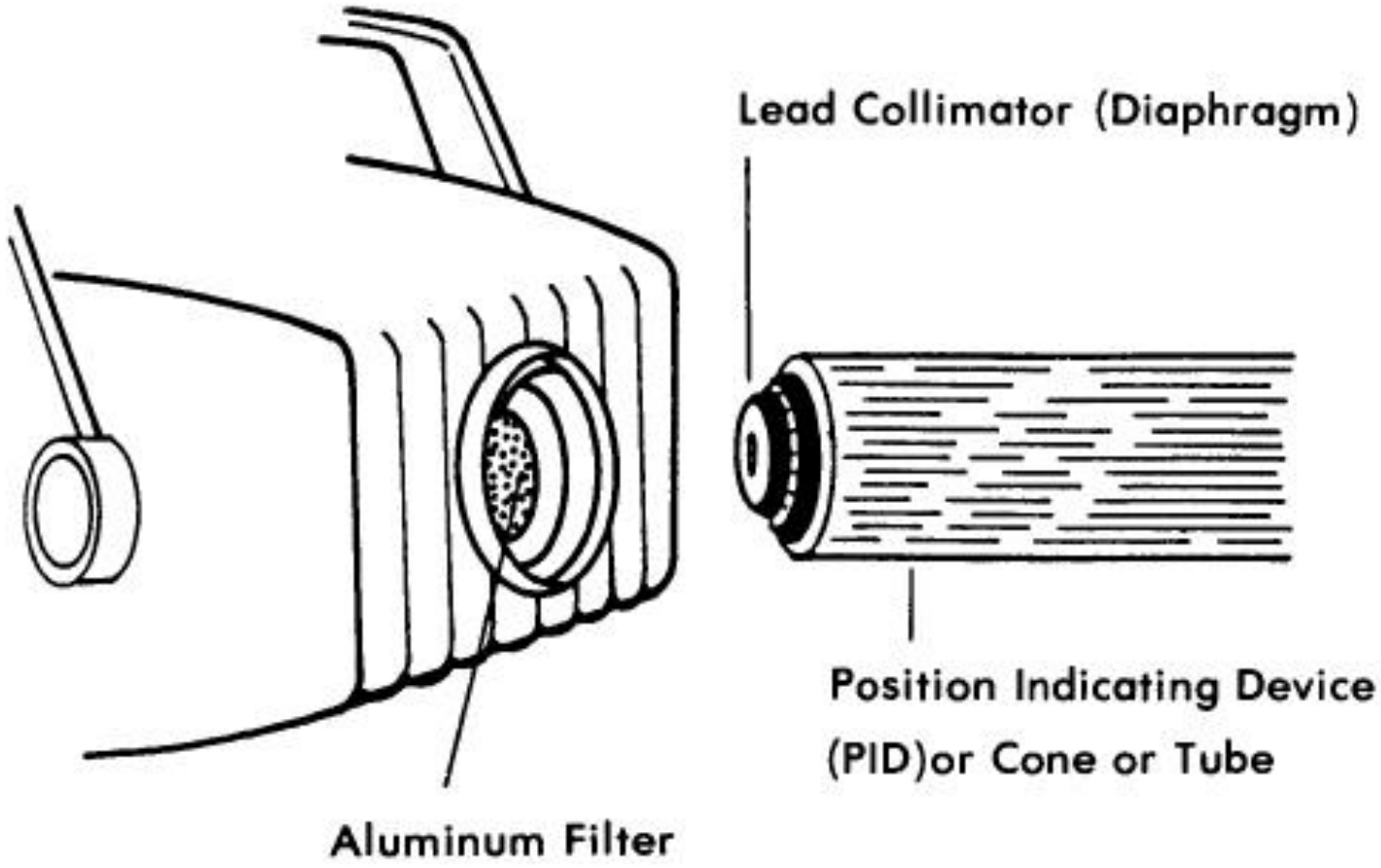


Collimator: a device used to regulate the size of the beam leaving the tube in parallel rays, helping to avoid stray radiation. Also termed a diaphragm., it is usually shaped similar to a lead washer on the connecting end of the PID (position indicating device) that also has lined walls to assist collimation.

Aperatus : opening in the lead collimator disk that regulates the size of the primary beam.

Filter: aluminum disks that are placed between the collimator attachment and the exit window of the tube to absorb weak radiation. The three types of filtration are:

- **Inherent filtration**: all filtration (tube wall, insulating oil, alminum disks) devices that filter weak, longer wavelength X-rays.
- **Added filtration:** filtration placed outside the tube head to meet safety standard.
- **Total filtration:** the sum of the inherent and added filtration, expressed in millimeters of aluminum equivalent.


Lead Collimator (Diaphragm)
Position Indicating Device
(PID)or Cone or Tube
Aluminum Filter

Control Factors in X-Ray Generation:

The production and the generation of X-rays in the tube head are affected by regulating conditions that are set on the control panel. Each of the following factors affects the outcome of the radiation:

Milliampere control: also known as milliampere; an increase in milliamperage increases the amount of electrons available and darkens the radiograph.

Kilovolt power: controls the force that attracts the electrons to the anode; helps to determine the penetrating power and the quality/energy of the radiation rays.

Exposure time: duration of the interval during which current will pass through the X-ray tube; this period may be stated as fractions of a second or impulses(60 pulses to a second). The amount of exposure that a patient actually receives is measured in milliampere seconds.

Target film distance: distance of the film surface from the source of radiation (target or focal spot).

Target object distance : distance between the anode target an the object to be radiograghed.

Film speed: A (slowest) to F (faster) speed; faster speed film requires less radiation exposure time for the patient

Types of X-ray Radiation:

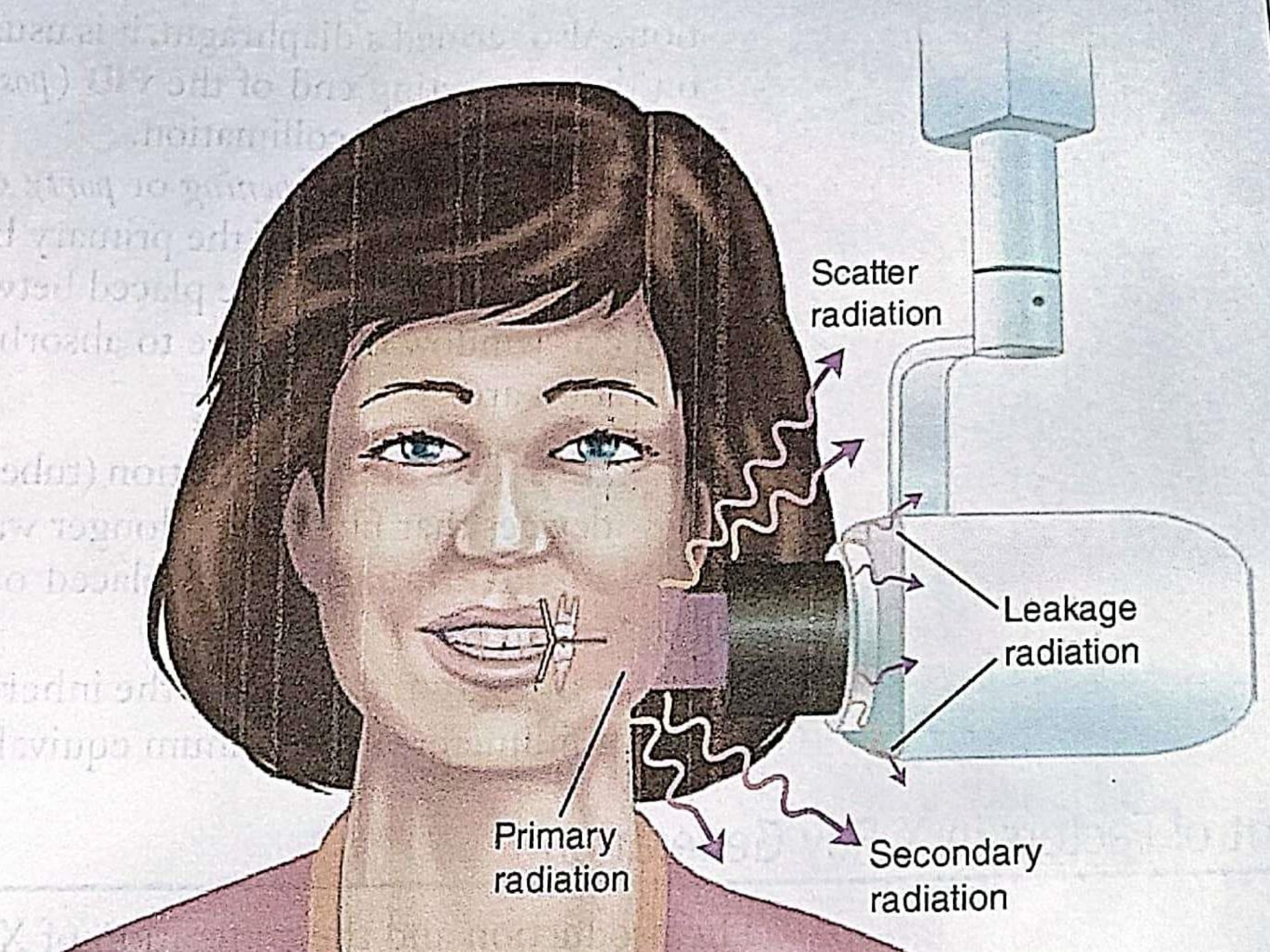
Different types of X-ray radiation , examples of these types are the following :

Primary radiation: central ray of radiation emitting from the tube head PID. Primary radiation is the desired radiation and is used to expose radiographic film.

Secondary radiation: radiation given off from other matter that is exposed to the primary beam.

Scattered radiation: radiation deflected from its path during its passage through matter; may be deflected or diffused in all directions, becoming attenuated or another form of secondary radiation.

Stray radiation: also called leakage, any radiation other than the useful beam produced from the tube head. A faulty or broken tube head may be the source of stray radiation.


Scatter radiation
Leakage radiation
Primary radiation
Secondary radiation

Properties of Roentgen Rays

Roentgen rays are considered hazardous and dangerous to the body tissues. X-radiation is made possible by producing ions. An ion is a particle that carries an electrical charge. This unbalanced atom particle may attempt union with body cell atoms, causing ionizing mediation, or a charge in cell structure that has a variety of effects such as:

Sensitivity: ability of X-rays to penetrate and possibly ionize. The reproductive cells are more radiosensitive than the radioresistant body tissues cells. Younger cells are more sensitive than older cells.

Cumulative effect: long-term outcome of radiation. Repetition increases and intensifies the ionizing effect on cells for a buildup of damage. The **latent period** of exposure is the time interval between the exposure and the effect or detection.

Mutation effect: abnormal growth or development due to radiation causing a genetic change.

Types of Exposure

The two types of X-radiation exposure that will damage the body cells are:

Acute radiation exposure: radiation occurring from a massive short-term ionizing dose, such as an accidental exposure or explosion of radiation material.

Chronic radiation exposure: accumulated radiation cell damage from continual or frequent small exposures absorbed over a period of time.

Measurement of Radiation Energy

Some terms that are used to measure radiation effects and used, both laboratory and biological, are:

Roentgen (R) : (international unit is coulomb per kilogram (C/kg)) the basic unit of exposure to radiation; the amount of X-radiation or gamma radiation needed to ionize 1 cc of air at standard pressure and temperature conditions.

Rad (Radiation absorbed dose)(international unit is Gray (Gy))the basic unit of absorbed radiation dose equal to 100 ergs(energy unit) per gram of tissue or 100 rad = GY.

Rem(roentgen equivalent measure): (international unit is sievert (Sv)) the unit of ionizing radiation needed to produce the same biological effect as 1 roentgen of radiation. 1 Sievert=100 Rem

RBE (relative biological effectiveness): unit of measurement used to determine amount of biological absorption effects on body tissues by different types of radiation energy.

Coulomb: international electromagnetic measurement abbreviated as C; 1 C per kilogram (C/kg) is equal to 3880 roentgens.

Maximum permissible dose: highest rate of exposure permissible for the occupationally exposed person. The formula for calculating this factor is (5 rem per year) – [age – 18] * 5 rem per year = MPD.

Radiation protection

Among the equipment and methods of protection against overexposure of X-radiation to the patient and the operator are:

ALARA: (as low as reasonably achievable) a policy of using the lowest amount of radiation exposure possible. Measures to accomplish this include proper exposure and protection aids, use of fast films, good techniques in exposure and developing and questioning the patient regarding recent exposure.

Dosimeter: operator's radiation monitoring device with ionizing chamber or a device to indicate exposure and measure accumulated doses of radiation.

Lead apron/thyrocervical collar: patient apparel with lead protection for genetic cells in the torso and the thyroid glands in the cervical area.

Lead barriers, shields: devices used by operators to block out scattered radiation.

Composition, Types, and Qualities of Dental Radiographs

Since the discovery of radiation and the application of its use in dentistry, dental radiographs have been film based, the information obtained by the exposure, processing, and storage of films has been considered the conventional method and is the most popular universal use.

During the 1980s and 1990s with the expanding use of computers, a new method was devised that changed the current analogue information of the film into digital signals that could project an image onto a computer screen instead of film. This method of data collection has been termed digital radiography and is becoming more popular in use.

Claims that digital radiography requires less radiation to the patient, is faster in delivery with no chemical processing, is more patient appealing, and is easier to diagnose must be weighed against the high cost of the machine process outlay.

No matter which method is used for dental radiographs, both types produce a two-dimensional output, and both require radiation involvement.

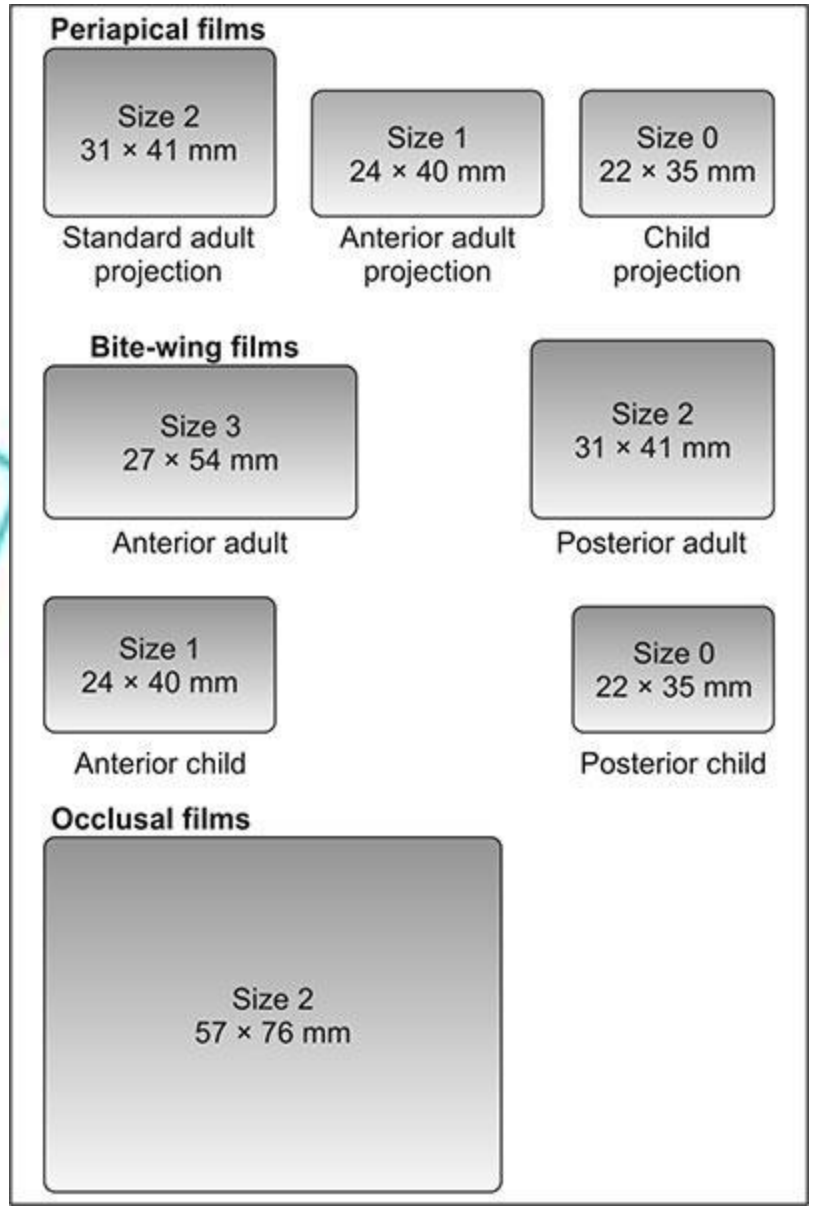
The operator must understand and observe the background information of production, use, and radiation safety for dental X-rays.

Conventional Radiographs

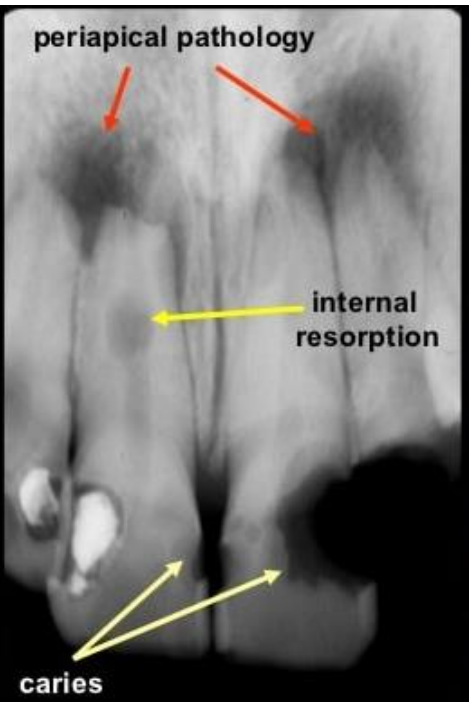
Conventional dental radiographs are composed of a celluloid base that supports an emulsion containing silver bromide, silver sulfide, and silver halide crystals. This emulsion is sensitive to light and radiation so that when exposed and processed, it will record a radiographic image.

Radiographs may be exposed within the oral cavity or outside the mouth. Most intraoral dental film packets contain one film, but they are also supplied in double film packets.

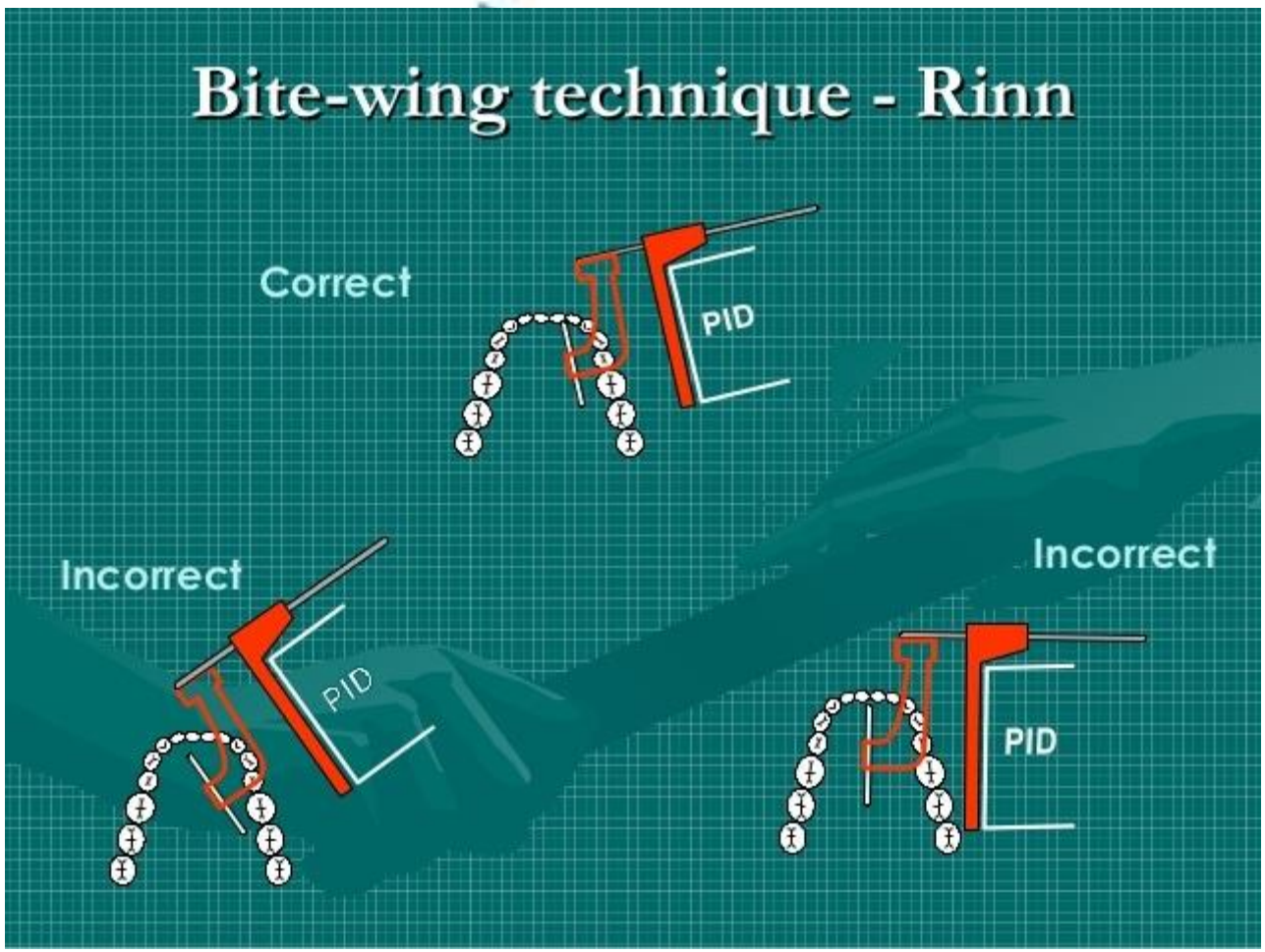
There are several basic kinds, sizes, and speeds of conventional dental film:



Periapical film packet: size 0, 1, or 2; used for the intraoral periapical view of the entire tooth or teeth in a given area along with adjacent tissues and oral structures. This film may also be placed in a device or loop to expose an intraoral bitewing view and may be ordered in a double film packet, if desired.

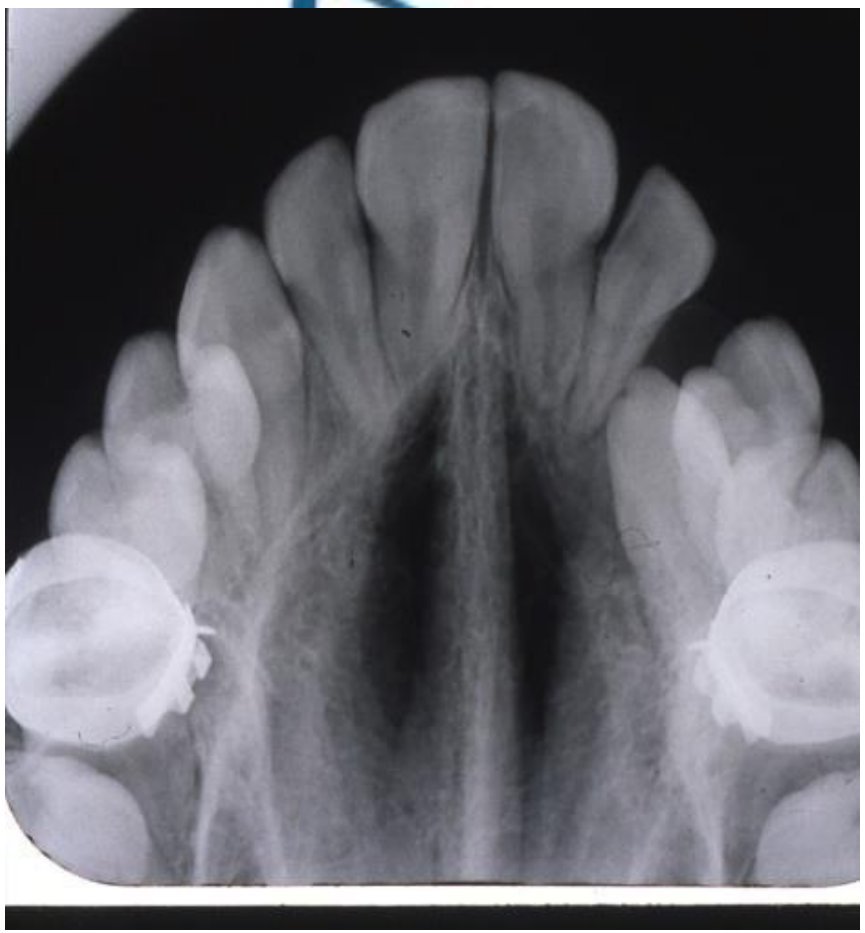


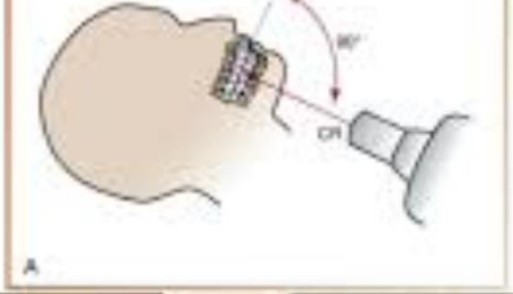
Bitewing film packet: film used to record crown and interproximal views of both arches in occlusion; used intraorally with attached bite tab. Other film sizes may be adapted to accomplish this task.



Film speeds: film are rated A to F according to the amount of exposure needed, with A needing the most time. Popular trade names for Kodak film are D-Ultra-speed, E-Ektavision, and F-Insight. Other manufacturers have similar trade names for films from A to F.

Occlusal film packet: size 4; film that may be used intraorally or extraorally to expose large areas .These film packets may contain more than one film and are marked and color-coded to identify the amount of film enclosed.

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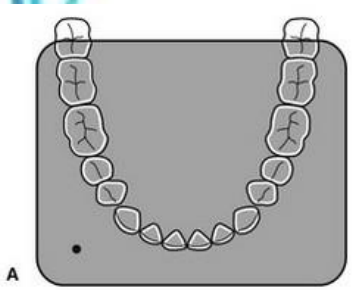
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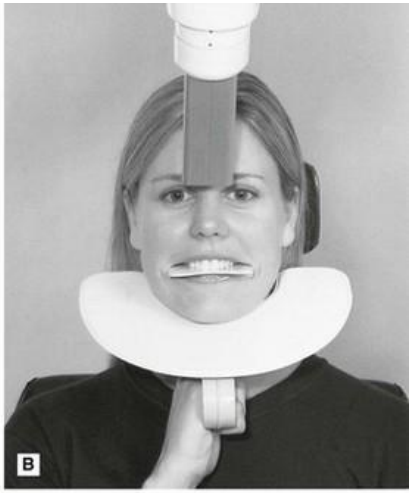
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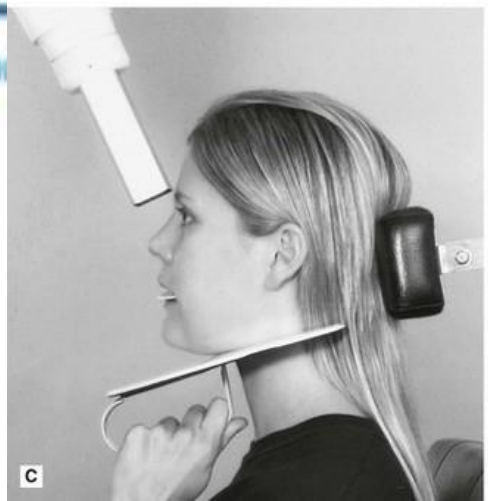
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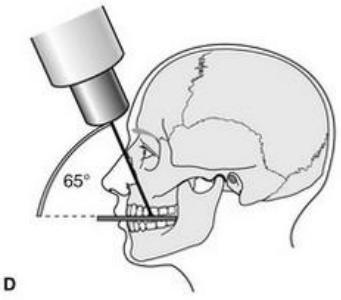
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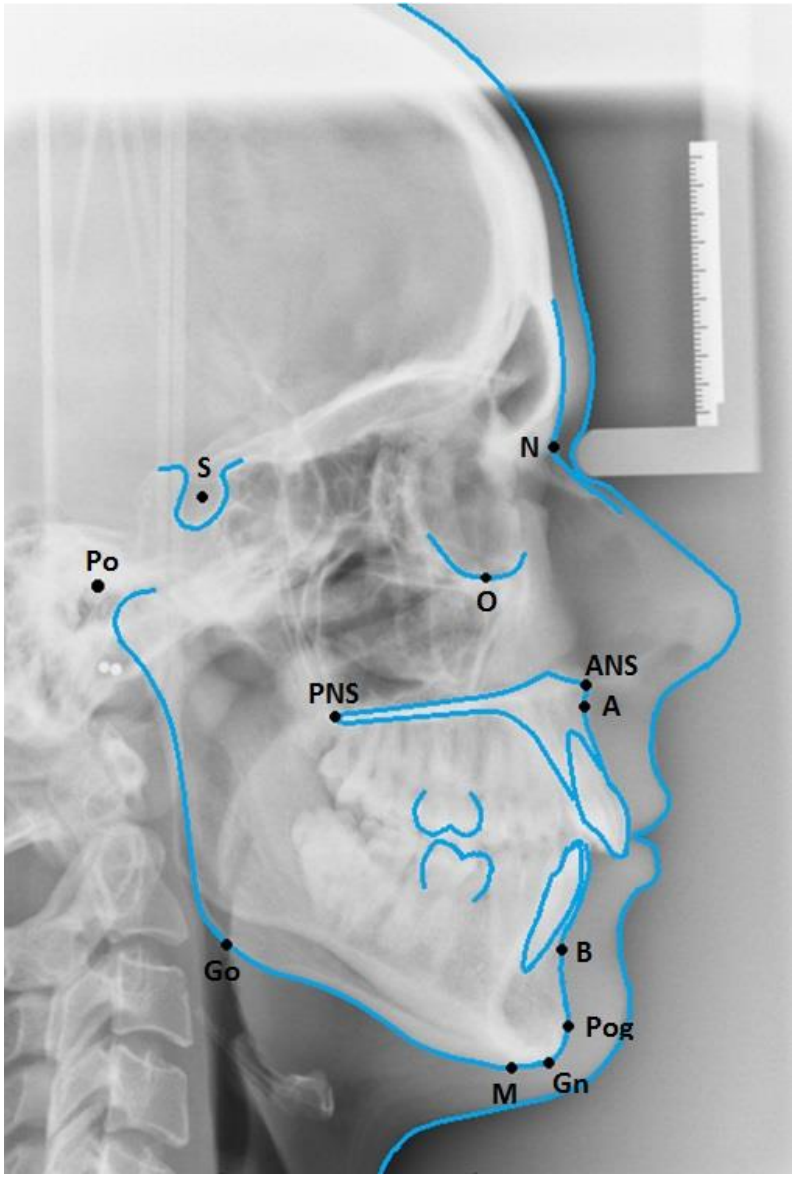
Extraoral films: radiographs exposed outside the oral cavity; larger in size and loaded in a film cassette or wrapped for protection from light rays.

Cephalometric film: also called headplates. These extraoral radiographs of the head are used in orthodontic, oral surgery, and sometimes in prosthodontic dentistry.



Cephalostat: a device used to stabilize the patient's head in a plane parallel to the film and at right angles to the central ray of the X-ray beam. It is used for large radiographs of the head.

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Panoramic radiograph: a special radiograph capturing a view of the entire dentition with the surrounding structures on one film. The extraoral film is placed in the machine's cassette and rotates around the patient at the same speed as the tube head rotation, providing a panoramic view. It is in popular use in orthodontics and oral surgery.

Digital Radiographs

Conventional radiographs are basically "hard copy" pictures that require film and chemical processing. Digital radiography is the electronic exposure and collection of analog data that is converted to digital information and projected on a computer screen. The collection of this data is obtained through the use of one of the two main types of sensors: CCD or PSP.

The CCD (charge coupled device) sensor

The ,PSP (photostimulatable phosphor device) sensor

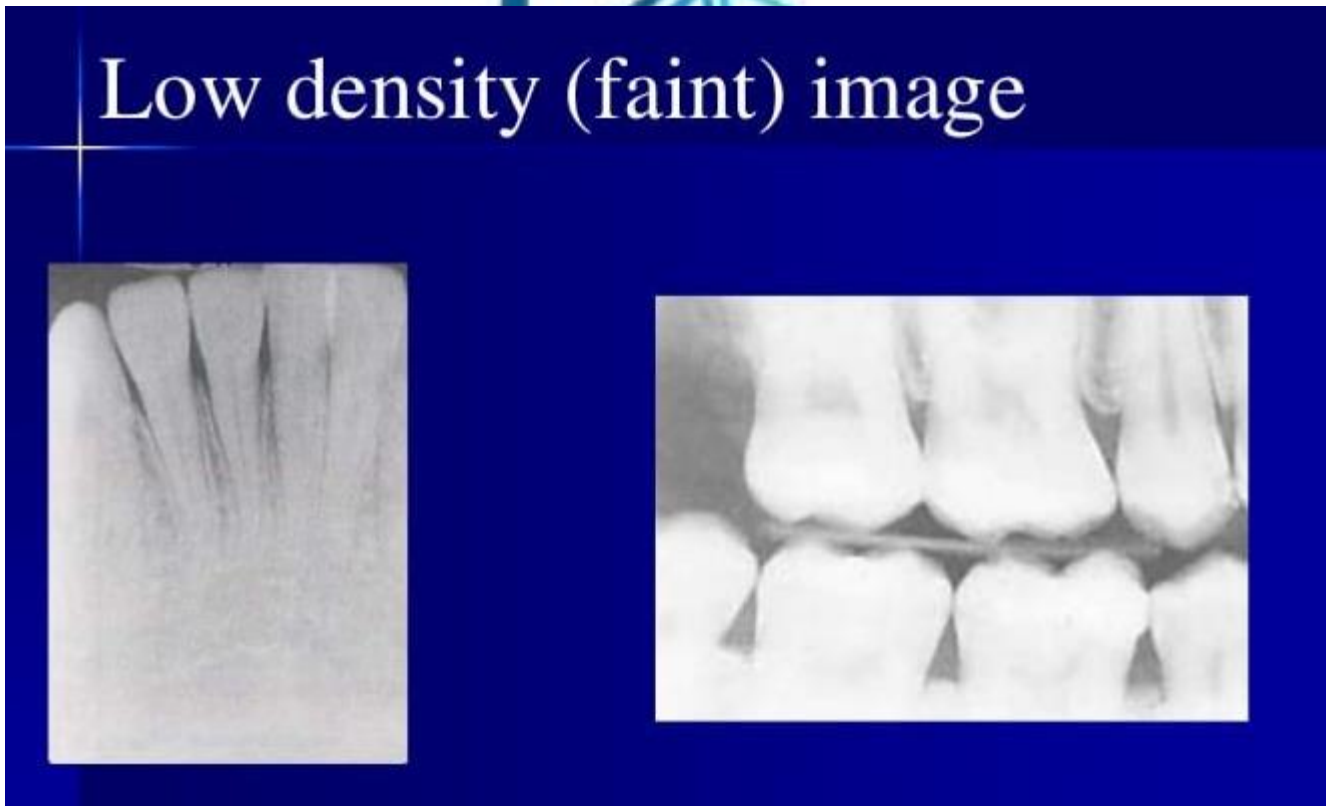
The digital radiography methods reduce the patient's radiation exposure time.

Diagnostic Qualities for Dental Radiographs

Dental radiographs must exhibit certain qualities to be effective. Relevant terminology related to radiography quality is defined and explained in the following:

Contrast: variations in shades from black to white. A radiograph exhibiting many variations in shades is considered to possess long-scale contrast. Increased kilovoltage helps to produce this effect.

Density/brightness: amount of film blackening associated with the percentage of light transmitted through a film. An increase or decrease in density is accomplished by an increase or decrease in milliamperage and exposure time.



Detail: point-to-point delineation or view of tiny structures in a radiograph image. Proper exposure, and kvp selection provide good detail.

Definition/smoothness: outline sharpness and clarity of image exhibited on a radiograph. Movement of the film, patient, or tube head is the most common cause of poor definition or fuzzy outline called **penumbra**. Proper digital machine filtration of electronic noise can improve the sharpness and smoothing of the digital image.

Radiolucent: describes a radiograph that appears dark, or the ability of a substance to permit passage of X-rays, thereby causing the radiographic film to darken.

Radiopaque: the portion of the radiograph that appears light, or the ability of a substance to resist X-ray penetration, thereby causing a light area on the film.

- Dense structures, such as enamel (1), dentin (2), and bone (3), resist the passage of x-rays and appear radiopaque, or white.

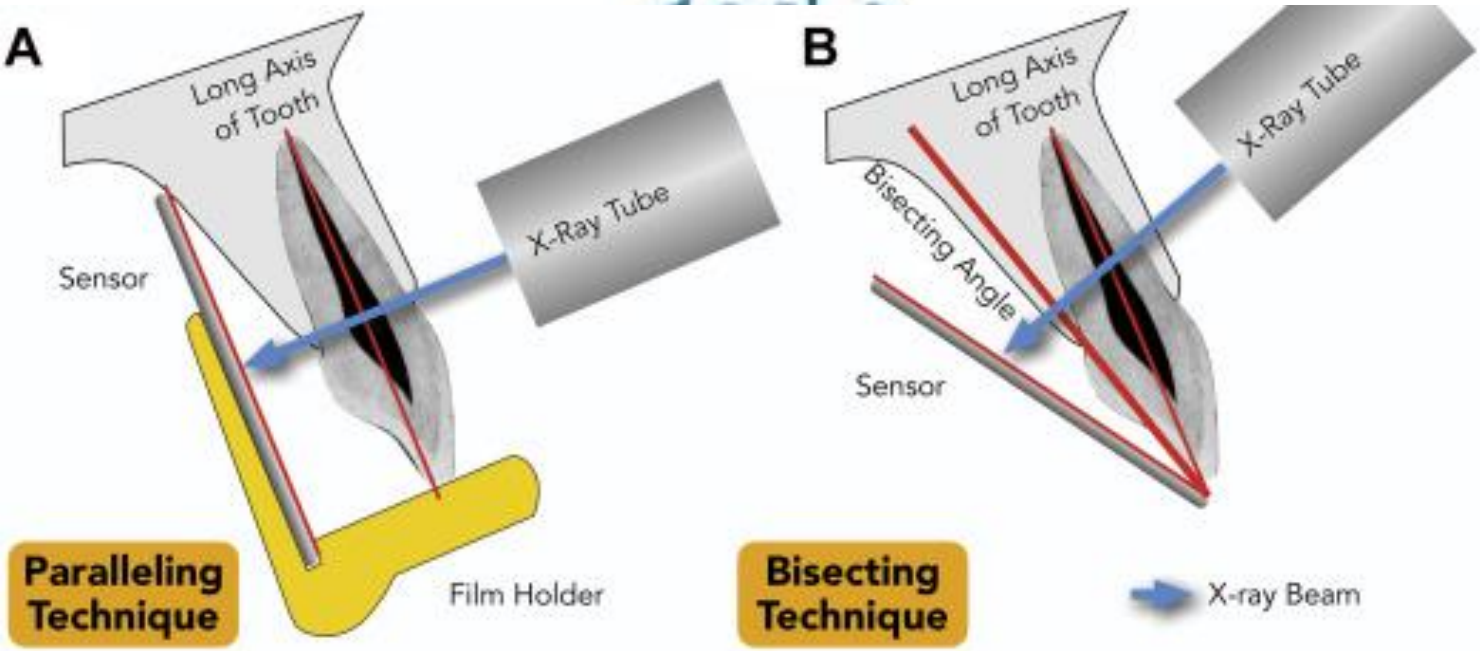
- Air space (arrow) appears radiolucent, or dark, because the dental x-rays pass through freely.

Techniques for Exposing Radiographs

The two basic techniques used by conventional and digital methods for exposure of intraoral radiographs are the bisecting angle and the parallel angle.

Bisecting angle: the central X-ray beam is directly perpendicular with an imaginary bisecting line of the angle formed by the plane of the film and the long axis of the tooth. This technique is also called the *short cone technique*.

Paralleling: the film packet is placed parallel to the long axis of the tooth and at a right (90 degree) angle to the central X-ray beam. This technique is also called the *extension cone* or *right-angle technique*.



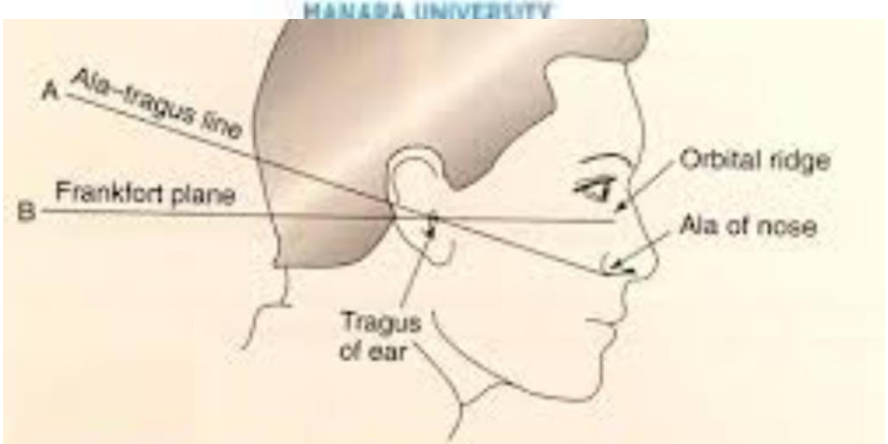
Positioning Terms for X-Ray Exposure

Various positioning method and angulations that affect the outcome of exposure are:

Sagittal plane: also called midsagittal plane; imaginary vertical line bisecting the face into a right and left half; important during exposure to determine positioning of the patient.

Ala-tragus line: imaginary line from the ala of the nose to the tragus, center of ear. This line is important for positioning the patient in the bisecting-angle technique.

Frankfort plane: imaginary line from the tragus of the ear to the floor of the orbit that is used to align the maxillary arch parallel to the floor; used mostly for extraoral films. Many machines that expose large extraoral films and digital images have a stabilizing chin rest or an aiming light to ensure this directional position.



Positioning Devices

Positioning and holding devices are used to help produce a good radiograph:

PID: position indicating device, formerly called a *cone*; may be a *long cone* or a *short cone*; may be round or rectangular, open-ended tube. It is used to collimate and direct the central beam, and it also determines the target-surface distance.

Film-holding instrument: device used to place retain the film or sensor in the oral cavity during exposure..

Locator or aiming rings are color-coded to designated area placement, such as:

Blue = anterior placement

Yellow = posterior placement

Red = bitewing placement

Green = endodontic placement

B

Biteblock: a device inserted between the teeth to hold the film during exposure; made of wood, or plastic.

Bite loop/tab: paper tab or a celluloid circle placed around periapical film, enabling the film to be used in a bitewing position. This combination is used in place of a commercially manufactured interproximal film. Some bite loops are constructed to assist with stabilizing and holding the digital sensor in the film-holding device.

Film-safe container: a lead-lined container used to hold exposed films until processing; protects the film from exposure to scattered or secondary rays during exposure of films.

Radiographic Film Processing

After exposure of the dental film to radiation, the film must be processed or developed to present a picture of the existing conditions. Radiograph processing is a procedure for bringing out the latent image on a film and making the exposure permanent. The procedure involves developing, rinsing, fixing, washing, and drying. Processing may be completed in an automatic film processor or by manual methods in a processing tank. Following are terms related to film processing:

Developing: chemical process using the chemical elon to bring out contrast and another chemical, hydroquinone, to show contrast in films. Developing brings out the latent image on the film's silver halines that were affected or darkened by radiation.

Accelerator: solution used to swell the film emulsion during the processing.

Activator: solution used to aid other chemicals in the processing activity.

Replenisher solution: super-concentrated developing solution that is added to the developing tank to restore levels.

Rinsing: water bath used to remove chemical liquids from films during solution exchanges.

Fixing: chemical process that stops the developer action and "fixes" the image, making it permanently visible.

Hyposulfite or hyposulfite of sodium: chemical that removes exposed and unexposed silver grains from the film.

Drying: procedure to dry films after chemical and water baths.

Safelight: special light or filtered light that can remain on during the developing procedure.

Assorted Radiographic Errors

When dental radiographs have not been exposed properly or handled in a clean manner, a faulty film will result. Included among the various radiographic errors seen in the dental facility are:

Elongation: image of the tooth structure appearing longer than the actual size; caused by insufficient vertical angulation of the central ray.

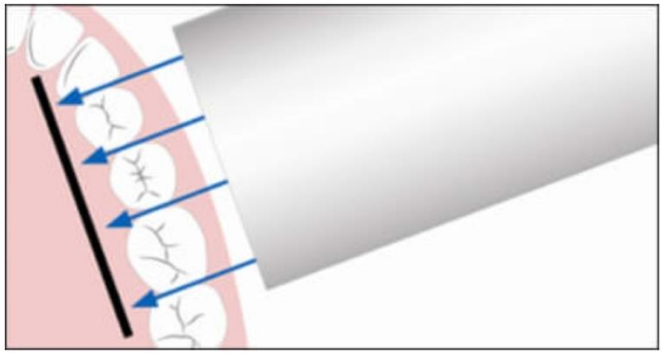
Foreshortening: tooth structures appear shorter than their actual anatomical size; caused by excessive vertical angulation of the central ray.

Overlapping: distortion of the film showing an overlap of the crowns of the adjacent teeth superimposed on neighboring teeth; caused by improper horizontal angulation of the central ray.

Cone cutting: improper placement of the central beam, which produces a blank area or unexposed area on the film surface caused by lack of exposure to radiation, such as when the PID is not centered properly on the film.

Clear film: a totally clear film indicates that no radiation has affected or exposed the film.

Horizontal Overlapping

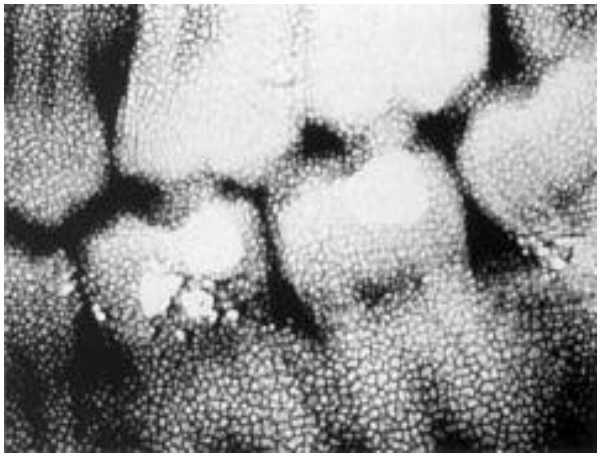


Correct Horizontal Angulation Entry

Underdeveloping: insufficient processing with weak chemicals or incorrect time or temperature that results in light, difficult-to-view films.

Overdeveloping: overprocessing that results in radiographs that are too dark and difficult to interpret.

Reticulation: crackling of film emulsion caused by wide temperature differences between processing solutions. Reticulation gives a stained glass window effect.



Fog: darkening or blemish of film that may be caused by old film, or contaminated solutions, faulty safelight, scattered radiation, or improper storage of films.

Penumbra: poor definition, fuzzy outline, or secondary shadow around the primary form; may be caused by movement or exposure errors.

3D Radiology

Since the discovery of X-rays, radiographs have been viewed in a 2D effect. Digital radiography with its use of computer assessment of exposed pixels produces an electronic image, also in two dimension, but with the additional application of *voxels*, a third dimension is added to the finished product.

In the past, exposure to the target surface was applied in a constant straight line, but the channeling of the radiation into a rotating cone beam provides variations in the exposure to the target. A layer view within the body is produced while images above and below that layer are made invisible by blurring. This assorted information is sent to computer software, which measures, analyzes, blocks out, and concentrates in specific slice or section areas. This collected data consists of multiple images and produces 3D views of the target area. In-depth measurements and views are particularly helpful for bone depth for implantology, bone growth for orthodontic evaluation, sinus lifts, and many structural analyses for oral surgery techniques as well as providing more detail for the dentist in planning patient treatment. There are other uses of radiation to specific body areas, such as salivary glands and TMJ joints, which will be discussed in other chapters.

Some dental terminology words applied to 3D cone beam computerized tomography, or CBCT, are:

CBVT: another term for CBCT.

Tomography: the act of gathering and data measurement of a slice or section under view; imaging by sections.

Tomogram: the finished image product in a tomography procedure.

Polytomography: several slice or sections of the tooth or body.

Laminagraphy: same as tomography; technique in which tissue image is collected and measured in slice or sections.

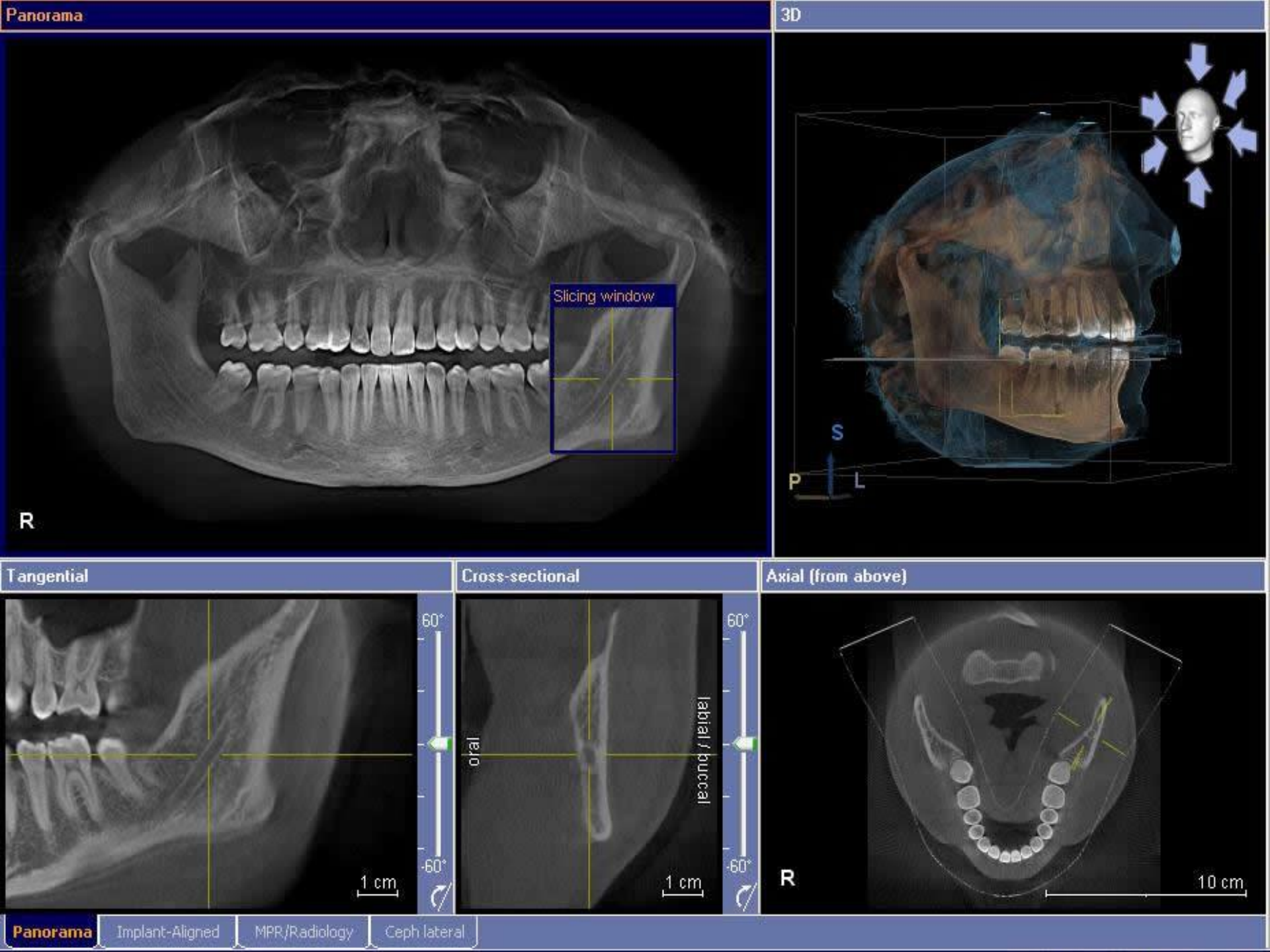
Voxel: the exposure of voxels instead of pixels produces a 3D effect in the image:

Axial view = *top to bottom view.*

Sagittal view = *side to side view.*

Coronal view = *front to back view.*

Volumetric view or study = *addition of depth produces a 3D image with added volume.*


Panorama
Slicing window
R
3D
S
P
L
Tangential
60°
-60°
1 cm
Cross-sectional
oral
labial / buccal
60°
-60°
1 cm
Axial (from above)
R
10 cm
Panorama
Implant-Aligned
MPR/Radiology
Ceph lateral