BASIC BIOMEDICAL ENGINEERING ASSIGNMENT (5 MEDICAL DEVICES..)

21111002- Aayush Joshi

28 January 2022

0.1 DENTAL X-RAYS:

a) OVERVIEW
b) WHY WE USE THEM
c) TYPES OF X-RAYS
d) SUMMARY

0.2 OSMOMETER

a)WHAT IS A OSMOMETER?
b)PRINCIPLES OF OSMOMETER
c)APPLICATIONS OF OSMOMETER

0.3 NEBULIZERS

a)WHAT IS A NEBULIZER?
b) WORKING BASIS
c) TYPES OF NEBULIZER
d)PROS AND CONS

0.4 DERMATOSCOPE

a) HOW IT HELPS US
b)ABOUT DERMATOSCOPY
c) TYPES OF DERMATOSCOPES
d) ACCURACY AND IMPORTANCE

0.5 HEARING AIDS

a) WHAT ARE HEARING AIDS?
b)TYPES
c) WORKING
d) APPLICATIONS

Chapter 1

DENTAL X-RAYS

1.1 OVERVIEW-

Dental X-rays (radiographs) are images of your teeth that your dentist uses to evaluate your oral health. These X-rays are used with low levels of radiation to capture images of the interior of your teeth and gums. This can help your dentist to identify problems, like cavities, tooth decay, and impacted teeth.

Dental X-rays may seem complex, but they're actually very common tools that are just as important as your teeth cleanings. Dental X-rays help dentists visualize diseases of the teeth and surrounding tissue that cannot be seen with a simple oral exam. They also help the dentist find and treat dental problems early on, which can help save you money, unnecessary discomfort, and maybe even your life.

1.2 WHY WE USE THEM?

Dental X-rays are typically performed yearly. They can happen more often if your dentist is tracking the progress of a dental problem or treatment. If you're a new patient, you'll probably undergo dental X-rays so that your new dentist can get a clear picture of your dental health. This is especially important if you don't have any X-rays from your previous dentist.

Children may need to have dental X-rays more often than adults because their dentists might need to monitor the growth of their adult teeth. This is important because it can help the dentist determine if baby teeth need to be pulled to prevent complications, such as adult teeth growing in behind baby teeth.Dental X-rays are important because they give your dentist the whole picture. They help dentists see the condition of your teeth and also the roots, jaw placement, and facial bone composition. They will help your dentist find and treat dental problems before they become too serious or advanced.
Dental X-rays can show: 1)Cysts and other types of tumors 2)Decay beneath fillings 3)Bone loss in the jaw due to periodontal disease 4)Small areas of decay.

1.3 TYPES OF DENTAL X-RAYS-

There are several types of dental X-rays, which record slightly different views of your mouth. Such as:
1)**OCCLUSAL**- This X-ray is done when your jaw is closed to see how your upper and bottom teeth line up. It can also detect anatomical abnormalities with the floor of the mouth or the palate.This technique captures all of your teeth in one shot.
2)**Panoramic**-For this type of X-ray, the machine rotates around the head. Your dentist may use this technique to check your wisdom teeth, plan for implanted dental devices, or investigate jaw problems.
3)**Periapical.** -This technique focuses on two complete teeth from root to crown.
4)**BITEWING-**. This technique involves biting down on a special piece of paper so that your dentist can see how well the crowns of your teeth match up. This is commonly used to check for cavities between teeth.
5)**Extraoral**- X-rays may be used when your dentist suspects there might be problems in areas outside of the gums and teeth, such as the jaw.

1.4 SUMMARY-

While dental X-rays do involve radiation, the exposed levels are so low that they're considered safe for children and adults. If your dentist uses digital X-rays instead of developing them on film, your risks from radiation exposure are

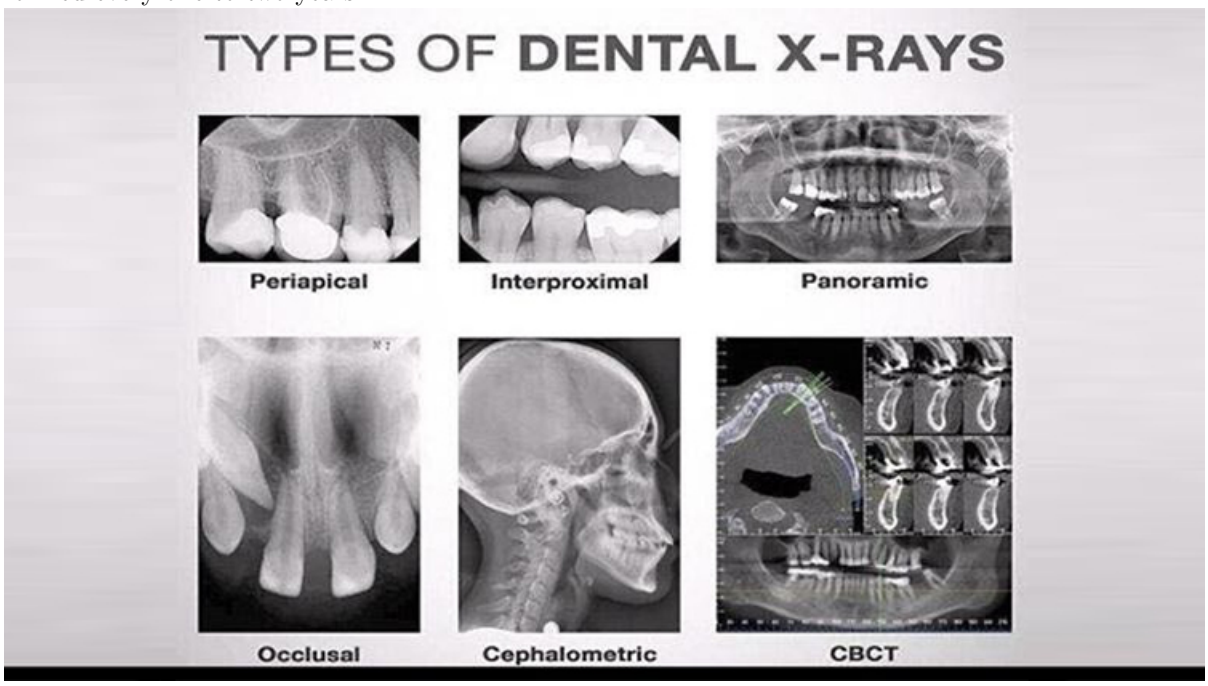
even lower.

Your dentist will also place a lead over your chest, abdomen, and pelvic region to prevent any unnecessary radiation exposure to your vital organs. A thyroid collar may be used in the case of thyroid conditions. Children and women of childbearing age may also wear them along with the lead bib.

Pregnancy is an exception to the rule. Women who are pregnant or believe they may be pregnant should avoid all types of X-rays. Tell your dentist if you believe you are pregnant, because radiation is not considered safe for developing fetusesLike brushing and flossing, getting regular dental X-rays is an integral part of your overall oral health.

Having a good checkup can be a relief, but this doesn't mean you shouldn't keep getting X-rays.

Depending on your age, health, and insurance coverage, X-rays may be performed every one to two years.



Chapter 2

OSMOMETER

2.1 WHAT IS OSMOMETER?

An osmometer measures osmotic concentration on the scale of milliosmoles (mOsm) per unit of weight (mOsm/kg). This provides valuable insights into the osmotic strength and pressure of various colloidal systems. Osmolality is a measure of a solution's osmotic concentration, which defines the total number of solute particles within the liquid that contribute to osmotic pressure. This is typically expressed as the number of osmoles (Osm) of solute per kilogram (kg) of solute. When it comes to measuring microscale solutes, such as ions in organic samples, measurements must operate on an order of thousands of times smaller than the osmole. These measurements are routinely conducted using osmometers.

2.2 PRINCIPLES OF OSMOMETER-

Osmolality is a measure of a solution's particle concentration by weight. Osmolarity is different in that it determines the total number of particles in a solution per unit of volume. The difference between these two properties is often marginal, as in clinical applications, where the physiology of osmotic solutions under examination are mainly aqueous. There are numerous different osmometer technologies available for determining the osmolality of aqueous samples (freezing point osmometers, vapor pressure osmometers, etc.). While the operating principles vary, they tend to measure osmolality as a function of changes to a constant parameter. In freezing point osmometry, for example, this constant is the freezing point of a solvent. A freezing point osmometer measure changes in a solvent's freezing point as a function of the total number of solutes.

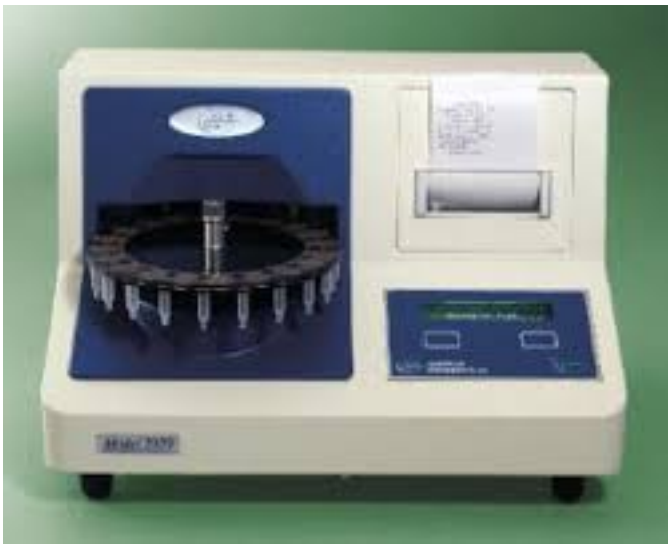
There are several different techniques employed in osmometry:

1)**Vapor pressure osmometers** determine the concentration of osmotically active particles that reduce the vapor pressure of a solution.
2)**Membrane osmometers** measure the osmotic pressure of a solution separated from pure solvent by a semipermeable membrane.
3)**Freezing point depression osmometers** may also be used to determine the osmotic strength of a solution, as osmotically active compounds depress the freezing point of a solution.

2.3 APPLICATIONS OF OSMOMETER-

Osmometers are used in an extremely broad range of application areas, primarily for clinical studies and treatment. They are used to measure the concentration of solutes in various biological samples, from blood plasma to human tears. These measurements can provide a rich array of data to assist in timely diagnoses of various conditions with significantly reduced healthcare costs.Freezing point osmometers have been used to screen isotonic beverages and determine their veracity against regulated standards. These range from sports drinks to non-alcoholic beer.Measurement of plasma and urine osmolality is quick, easy and accurate. The recognition of the interdependence of urine volume and osmolality on the excretion of the daily obligatory solute load assists in the diagnosis and management of fluid balance and renal excretory problems in the acutely ill. In addition, syndromes of osmotic disequilibrium present a challenge in metabolic care.


Model 3320
Osmometer



Chapter 3

NEBULIZER

A nebulizer is a small machine that creates a mist out of liquid medication, allowing for quicker and easier absorption of medication into the lungs.Nebulizer turns liquid medicine into a very fine mist that a person can inhale through a face mask or mouthpiece.A nebulizer is helpful for a variety of conditions, including:
1)Chronic obstructive pulmonary disease (COPD)
2)Asthma
3)Bronchiectasis
4)Cystic fibrosis
5)pulmonary fibrosis

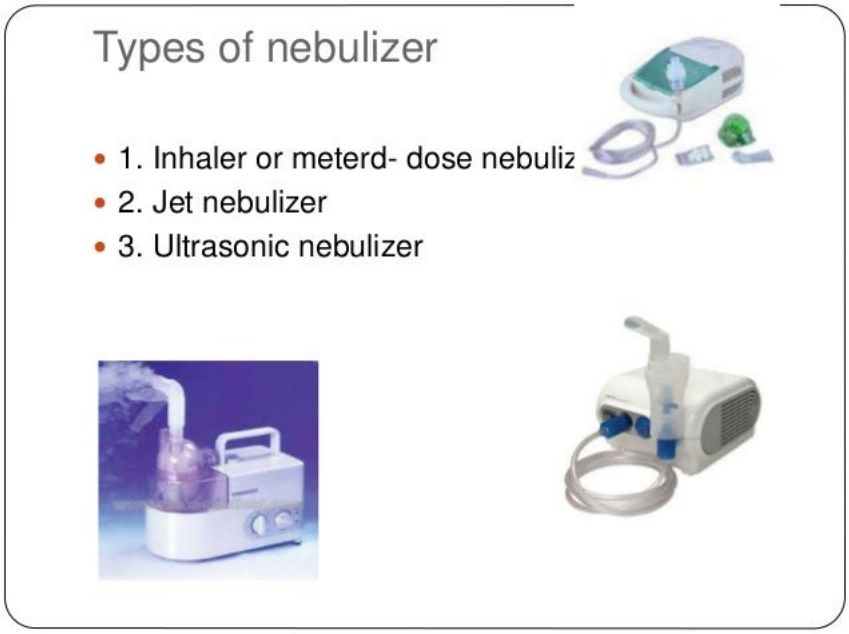
3.1 WORKING BASIS

A Nebulizer delivers liquid medication via pressurized air. While individuals with asthma typically use both nebulizers and inhalers, occasionally, a nebulizer may be easier to use — especially when it comes to young children who may not have the proper technique for an inhaler. However, when airways become narrow — like during an asthma attack — an inhaler is most likely the best choice, because a nebulizer can take some time to set up.
Examples of medications used in nebulizers include: 1)**Bronchodilators** are drugs that help to open up the airway.
2)**Medical-grade saline** (saltwater) solutions are solutions that help break up mucus in the lungs.
3)**Antibiotics** are used to help treat or prevent infections.

3.2 TYPES OF NEBULIZERS

There are three main types of nebulizers available:

1)**Jet nebulizers** make an aerosol out of medications using a compressed gas . These are the most common type of nebulizers.
2)**Ultrasonic nebulizers** make an aerosol via high-frequency vibrations. These are more commonly used in hospitals and typically are not for personal use.
3)**Mesh nebulizers** use a mesh cap with tiny holes that help dispense medication in a very efficient way. These nebulizers are newer and often more effective than jet nebulizers.



3.3 PROS AND CONS

PROS OF NEBUIZERS-
1)They are easier to use when you are having an asthma attack, since you don't need to take deep breaths while using one.
2)Multiple medications can be delivered at the same time.
3)A nebulizer may be easier to use with young children.
4)Useful for old people who cannot coordinate inhalers.
5)Useful in an acute attack situation for home self use.
CONS OF NEBULIZERS-
1)Nebulizers are usually not as easy to transport as an inhaler.
2)They often require a stationary power source.
3)Delivery of medications takes longer through a nebulizer than through an inhaler.
4)The cost of treatment goes up considerably. If the same usual asthma medication by inhaler is about 6 rupees a day, by nebulizer it would cost 60 to 80 rupees a day. For a few day's treatment that would not matter much. But for long term treatment it would be a concern for most.
5)There are chances of carrying the infection from unsterile chambers or tubings into the lungs, especially with long term use.
6)A lot of drug is wasted – that vapour which is coming out from the side.

Chapter 4

DERMATOSCOPE

4.1 HOW IT HELP US

A Dermatoscope is a hand-held imaging device doctors use to examine a person's skin, hair, or nails.Dermatoscopes use light and magnification to help a dermatologist see how a person's skin looks in more detail. Dermatoscopes help show details in the outer layer of skin that would not be visible to the naked eye. Since dermatoscopes can enhance a doctor's view of the skin, they can aid in the diagnosis of skin conditions, such as melanoma.

4.1.1 ABOUT DERMATOSCOPY

Dermatoscopy is the examination of skin lesions with a dermatoscope.Also known as dermoscopy or epiluminescence microscopy, it allows for inspection of skin lesions unobstructed by skin surface reflections. The dermatoscope consists of a magnifier, a light source (polarized or non-polarised), a transparent plate and sometimes a liquid medium between the instrument and the skin. When the images or video clips are digitally captured or processed, the instrument can be referred to as a digital epiluminescence dermatoscope.A dermatoscope is composed of a transilluminating light source and a magnifying optic (usually a 10-fold magnification). There are three main modes of dermoscopy:
1)**Nonpolarized light, contac**t
2)**Polarized light, contact**
3)**Polarized light, noncontact**
Polarized light allows for visualization of deeper skin structures, while nonpolarized light provide information about the superficial skin. Most modern dermatoscopes allow the user to toggle between the two modes, which provide complementary information.The typical application of dermatoscopy is early

detection of melanoma Aid in the diagnosis of scabies and pubic louse. By staining the skin with India ink, a dermatoscope can help identify the location of the mite in the burrow, facilitating scraping of the scabetic burrow. By magnifying pubic louse, it allows for rapid diagnosis of the difficult to see small insectsAid in the diagnosis of hair and scalp diseases, such as alopecia areata, female androgenic alopecia, monilethrix,Netherton syndrome, and woolly hair syndrome.Dermoscopy of hair and scalp is called trichoscopyWith doctors who are experts in dermatoscopy, the diagnostic accuracy for melanoma is significantly better than those who do not have any specialized training. Thus, there is considerable improvement in the sensitivity (detection of melanomas) as well as specificity (percentage of non-melanomas correctly diagnosed as benign), compared with naked eye examination.

4.2 TYPES OF DERMATOSCOPE

Dermatoscopes can range vastly in quality. High-quality dermatoscopes, usually in research centers, will give clearer images than low-quality ones.There are three main types of dermatoscopes. They include:

1)**Hand-held dermatoscope**: This type of dermatoscope is a simple hand-held device with a built-in light. They can magnify images by about 10–20 times. They do not connect to a monitor.

2)**Dermatoscope connected to a camera**: These dermatoscopes allow photos to be taken of the skin for later examination.

3)**Dermatoscope connected to a viewing device**: This type of dermatoscope allows for pictures, video, and shared viewing with doctors and patients during the examination.

4.3 ACCURACY AND ITS IMPORTANCE

According to a 2018 Cochrane review, dermatoscopes are more accurate in diagnosing melanomas than the naked eye alone when utilized by a trained professional. This is crucial as it can save a person time and potentially prevent them from undergoing surgery unnecessarily.

A 2019 review adds that a doctor can use a dermatoscope combined with examining other factors to accurately diagnose melanomas. These other factors include: **1)MEDICAL HISTORY**
2)AGE
3)FAMILY HISTORY
Dermatoscopes are hand-held devices that allow a doctor or person to see an area of the skin much better than by looking with an unaided eye. The instruments can help a doctor diagnose and distinguish between different lesions found on the skin. They can be helpful in the diagnosis of cancers, such as melanoma. A doctor can also use them to examine the hair and nails. There are simple models available as well as ones that can connect to cameras or monitoring equipment.


1989
1993
1997
2002
2003
2007
2013
2015
2016
2018
2019

Chapter 5

HEARING AIDS

5.1 WHAT ARE HEARING AIDS?

A hearing aid is a device designed to improve hearing by making sound audible to a person with hearing loss. Hearing aids are classified as medical devices in most countries, and regulated by the respective regulations. Small audio amplifiers such as plain sound reinforcing systems cannot be sold as "hearing aids".Early devices, such as ear trumpets or ear horns, were passive amplification cones designed to gather sound energy and direct it into the ear canal. Modern devices are computerised electroacoustic systems that transform environmental sound to make it audible, according to audiometrical and cognitive rules. Modern devices also utilize sophisticated digital signal processing to try and improve speech intelligibility and comfort for the user. Such signal processing includes feedback management, wide dynamic range compression, directionality, frequency lowering, and noise reduction.

5.2 TYPES

There are many types of hearing aids (also known as hearing instruments), which vary in size, power and circuitry. 1)**Body worn aids** were the first portable electronic hearing aids, and were invented by Harvey Fletcher while working at Bell Laboratories.Body aids consist of a case and an earmold, attached by a wire. The case contains the electronic amplifier components, controls and battery, while the earmold typically contains a miniature loudspeaker. The case is typically about the size of a pack of playing cards and is carried in a pocket or on a belt.
2)**Behind the ear** hearing aids are one of two major classes of hearing aids –

behind the ear and in the ear . These two classes are distinguished by where the hearing aid is worn. BTE hearing aids consist of a case which hangs behind the pinna. The case is attached to an earmold or dome tip by a traditional tube, slim tube, or wire. The tube or wire courses from the superior-ventral portion of the pinna to the concha, where the ear mold or dome tip inserts into the external auditory canal. The case contains the electronics, controls, battery, and microphone.

3)**In the ear aids** (ITE) devices fit in the outer ear bowl (called the concha). Being larger, these are easier to insert and can hold extra features. They are sometimes visible when standing face to face with someone. ITE hearing aids are custom made to fit each individual's ear. They can be used in mild to some severe hearing losses.

4)**Invisible-in-canal hearing aids** (IIC) style of hearing aids fits inside the ear canal completely, leaving little to no trace of an installed hearing aid visible. This is because it fits deeper in the canal than other types, so that it is out of view even when looking directly into the ear bowl (concha).

5)**Extended wear hearing aids** are hearing devices that are non-surgically placed in the ear canal by a hearing professional. The extended wear hearing aid represents the first "invisible" hearing device.

5.3 WORKING

Hearing aids work by amplifying sound through a three-part system:

1)The microphone receives sound and converts it into a digital signal.

2)The amplifier increases the strength of the digital signal.

3)The speaker produces the amplified sound into the ear.

Digital hearing aids can be customized to an individual's hearing loss. After hearing testing is completed, the hearing aids are programmed to the specific degree and pattern of hearing loss observed in the test results. Digital hearing aids have automatic features that can adjust the volume and programming for improved hearing in different environments.

5.4 APPLICATIONS

1)**Multiple listening programs**: Digital hearing aids are equipped with more than one listening program. Settings include situations where there is a lot of background noise as well as situations where there is little to no background noise. Hearing aids with multiple programs may automatically change between programs or can be manually changed by the individual. Some hearing aids may also come with remote controls.

2)**Directional microphone technology**: This is also a strategy for better hearing in background noise. Hearing aids that come with just one microphone function in an omnidirectional mode (meaning sound is picked up from all around). Hearing aids with directional microphone capabilities typically have two microphones and have the ability to focus (or direct) one microphone toward the sound source while the other attempts to decrease some of the background noise.