LASER THERAPY

INTRODUCTION

LASER means

- **Light Amplification of Stimulated Emission of Radiation**
- **It refers to the production of a beam of a radiation which differs from the ordinary light in several ways**
- **Now a days , used in :**

1. **Laser light shows**
2. **Compact disc player**
3. **Surgical incision**
4. **Ophthalmology**
5. **Gynecology**
6. **Dermatology**
7. **Physical therapy**

PROPERTIES OF LASER

MONOCHROMATICITY

- **Means laser light has single color**
- **As laser are of single wavelength and thus definite frequency**
- **Ordinary light ??**

COHERENCE

- Coherence means_ similar or synchronous behaviour
- Laser radiation are not only the of same wavelength but also has same phase
- First , temporarily coherent, means, Photons are in same phase with crest meeting crest and troughs meeting troughs in time
- Secondly, spatially coherent, means, the photons are unidirectional and stay in same phase over long distances and little spread of beam

COLLIMATION

- **Means laser beam remain in parallel.**
- **Do not diverge much and energy can be propagated over a larger distance**

PRODUCTION OF LASERS

- Electrons as the cloud of negative charge around the nucleus
- According to quantum theory electrons occupy certain energy levels around the nucleus
- Under normal circumstances ,electrons of atoms remains in lowest energy levels i.e. At the resting or ground state
- If enough energy is added, the electron gain energy n become negatively charge and nucleus become positively charge
- Then electron tends to return to a lower energy stat. the quantum energy is expressed in electron volts
- Greater the quantum energy ; lesser will be the wavelength
- A large no. of atoms with the electrons in the excited state can lead to amplification since one photon release a second and these two can release more and so on.

COMPONENT FOR LASER PRODUCTION

- **For the production of a laser radiation, the device must consist of the following component:**

1. **Lasing medium**
2. **Resonating chamber**
3. **Energy source**

LASING MEDIUM

- The material which is capable of producing laser is known as lasing medium
- It can absorb energy from the external source and then gives off its excess energy as photons of light
- Lasing medium could be solid crystal, or semi conductor, liquid or gas.
- The lasing medium in low intensity or cold laser are either helium-neon(He-Ne)
- Or semiconductor, i.e. gallium-arsenide(Ga_As)

RESONATING CHAMBER

- **The resonating chamber contains the lasing medium which is surrounded by two parallel mirrors on either ends.**
- **One of the mirror has 100% reflectance while the other has slightly less reflectance.**
- **The mirror with slightly less reflectance serves as an output device which allows some of the photons to escape through it**

ENERGY SOURCE

- **A flashgun is used to excite the electrons of the lasing medium.**
- **The source of flashgun is usually current electricity**

TYPES OF LASER

Various types of lasers are available now a days. The commonly used are

1. Ruby laser(or crystal laser)
2. Helium-neon laser(gas laser)
3. Diode laser(or semi conductor laser)

RUBY LASER(OR CRYSTAL LASER)

- It contain synthetic laser as lasing material
- Synthetic medium(aluminium oxide and chromium) are used rather than the natural one to ensure purity of the medium- ensures physical characteristics of laser
- Aluminium oxide with the traces of chromium oxide forms a 10 cm long and 1 cm wide synthetic ruby rod
- A helical electric discharge tube containing xenon tube is wound around the ruby rod
- Both ends are made reflecting by silvering the surfaces with one end 100% reflection and other slightly less
- The xenon tube is used to give intense flash of white light which excites the ruby molecules and raises the electron to a high energy levels

- As the excited stat is unstable, the electron return to the ground by releasing a photon. This is known as *spontaneous emission*
- The rate of supply of energy exceeds to a greater extent which leads to a large no of atoms at higher energy levels. This is known as *population inversions*
- Atoms in their excited stat are encountered by photons and this leads to further stimulated emissions
- This excited electron falls to its resting stat and gives off exactly same energy as that of photon which collide with it(photon of 694.3nm wavelength)
- Hence a beam of red laser with a wavelength 694.3 nm is emitted

HELIUM-NEON LASER(GAS LASER)

- Gas laser consist of a mixture of primary helium and neon in a low pressure tube
- This low pressure tube is surrounded by flash gun which excites the atom to higher energy stat
- Thus photons released by the spotaneous emission and have a wavelength of 632.8nm
- These photons reflect to and fro to the tube and collide with the atoms of higher energy levels
- This leads to stimulated emission with the release of similar photons
- intense beam of light emerges from the narrow partially transmissive which is red in colour and has a wavelength of 632.8nm

DIODE LASER(OR SEMI CONDUCTOR LASER)

- Gallium and arsenide are used as a diode or semiconductor to produce an infra-red invisible laser with a wavelength of 904nm
- In these with an external electric potential, positively charged holes are thrown from the p type gallium-aluminium-arsenide layer into the active layer of gallium-arsenide
- The negatively charged electron interact with the active layer and thus photon of light is released
- The photons are reflected to and fro and emitted as a laser beam from one partially transparent end
- By varying the ratio of gallium to aluminium, desired specific wavelengths are obtained.
- The advantage of semi conductor laser diode is that these can either emit a continuous or pulse out put

TECHNIQUES OF APPLICATION

TECHNIQUES OF APPLICATION

Methods of applications are quit simple. Generally laser energy is emitted by hand held applicator for therapeutic purposes. The gallium arsenide laser contain the semi conductor or diode element at the tip of the applicator, whereas the helium-neon laser contains their components inside the unit and delivers the laser light to the target area via a fiber optic tube. This causes the divergence of the beam

- **Two methods are generally used**

1. **Grid method**
2. **Scanning method**

THE GRIDE METHOD

- the treatment area is divided into a grid each of 1 cm2
- the hand held applicator should be in light contact with the skin and directly perpendicular to the tissue
- Each cm2 is stimulated for a specific period of time

THE SCANNING METHOD

- No contact is made between the tip of laser and the patient's skin
- The tip of applicator is held at a distance of 5 to 10 mm
- Since the divergence of beam occurs, there is decrease in the amount of energy applied as the distance

DOSAGE PARAMETERS

1. WAVELENGTH

- **Depends on lasing medium used**
- **For superficial conditions like wounds and ulcers, visible red laser is used**
- **For deep conditions of muscle and bone, infra red laser is used.**
- **Cluster probe laser having several diodes are used for the larger area of soft tissues**

2. POWER

- **The power output is measured in watts.**
- **Since the power output used therapeutically is quit small, mW is generally used**
- **Some times percentage of out put is generally used , i.e. 10%, 20%, or 30% of total power output**

3. ENERGY

- **The energy delivered to the treatment head is delivered to the treatment tissue is expressed in Jouls**
- **Calculated by**
- **Energy (in Jouls)= Power(in watts)* Time (in seconds)**
- **So time for specific treatment can be calculated id energy required is known**

4. POWER DENSITY

- **Power density decreases as the area between the tip of the applicator and the part to be treated increases**
- **Power density is expressed as**
- **Power density= Incident power / area in cm2**
- **Total power used therapeutically is this calculated by inverse square law**

5. ENERGY DENSITY

- **Calculated as**
- **Energy density= power(W) . Time(sec) / Area(cm2)**
- **Dosage in Laser therapy is calculated in terms of energy density applied , expressed in Jouls / cm2**

INTERACTION OF LASER WITH BODY TISSUE

- Used for non thermal effects
- Visible rays remarkably absorbed in haemoglobin
- Infra red absorbed in water
- Absorption results in transfer of energy
- Human body consist of 70% water,30% organic
- Organic material , absorb VR , contains chromophres
- Chromophores are molecular structures which get excited by the visible spectrum due to its configuration.
- In human body, haemoglobin melanin contain chromophores and thus absorbs laser energy

PHYSIOLOGICAL EFFECTS AND THERAPEUTIC USES OF LASER

WOUND HEALING

- Chemotactic activity
- Vascular changes
- Release of chemical mediators
- Red light is effective
- Increase tissue proliferation thus imp in, wounds of burns, surgical incisions, diabetic ulcers, pressure sores
- Wound margins….. Dir contact 4 to 10 jouls/cm2
- Wound bed noncontact…….. 1 to 5 jouls/cm2

TENSILE STRENGTH SCAR TISSUES

- **Tensile strength of scar tissue treated with laser therapy is more.**
- **Tensile strength_____ increase level of collagen_____ fibroblast mediated functions_____ laser**
- **Wound treated with laser therapy_____ more epithelialisation _____ less exudate**

MUSCULOSKELETAL CONDITIONS

Over use tendinitis

Acute conditions

Arthritic conditions

PAIN RELIEF

Acute

Chronic

BONE AND CARTILAGE HEALING

DANGERS AND CONTRAINDICATIONS

1. **Effects on eye**
2. **Effects on cancerous growth**
3. **Effects on pregnant uterus**
4. **Effects on infected tissue**
5. **Hemorrhagic areas or cardiac conditions-----**

--

THANKS!!!!!!!!!