LASERS IN DENTISTRY

Sundus Abdul Wadood
OMFS
Basrah Dental College

The term **LASER** is an acronym for

Light

Amplification by the

Stimulated

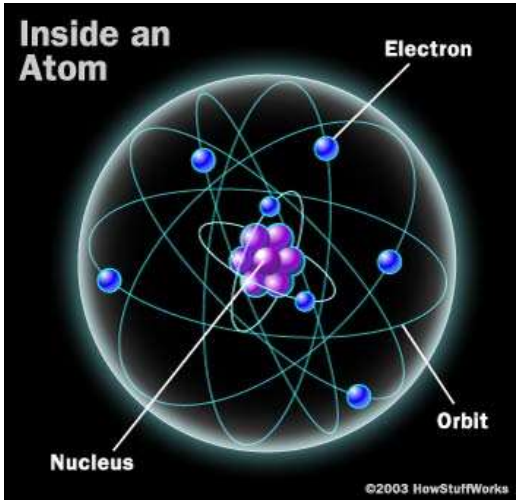
Emission of

Radiation

HISTORY

- 1961 Javan used a mixture of Helium-Neon (HeNe).
- 1961 Johnson used Neodymium ion as a dopant in calcium tungstate Nd:($CaWO_4$) .
- 1961 Johnson Nd:YAG (yttrium-aluminum-garnet) Laser
- 1964 Patel used CO_2 Laser (Carbon-dioxide gas) in O&MFS.
- 1964, Argon Laser
- 1980 the pulsed-dye laser, Q-switched ruby, copper vapor, & holmium-YAG lasers used in selected surgical cases like angiodysplasias & arthroscopic surgery of the TMJ.

LASERBASICS



Light **A**mplification by **S**timulated **E**mission of **R**adiation

Coherent

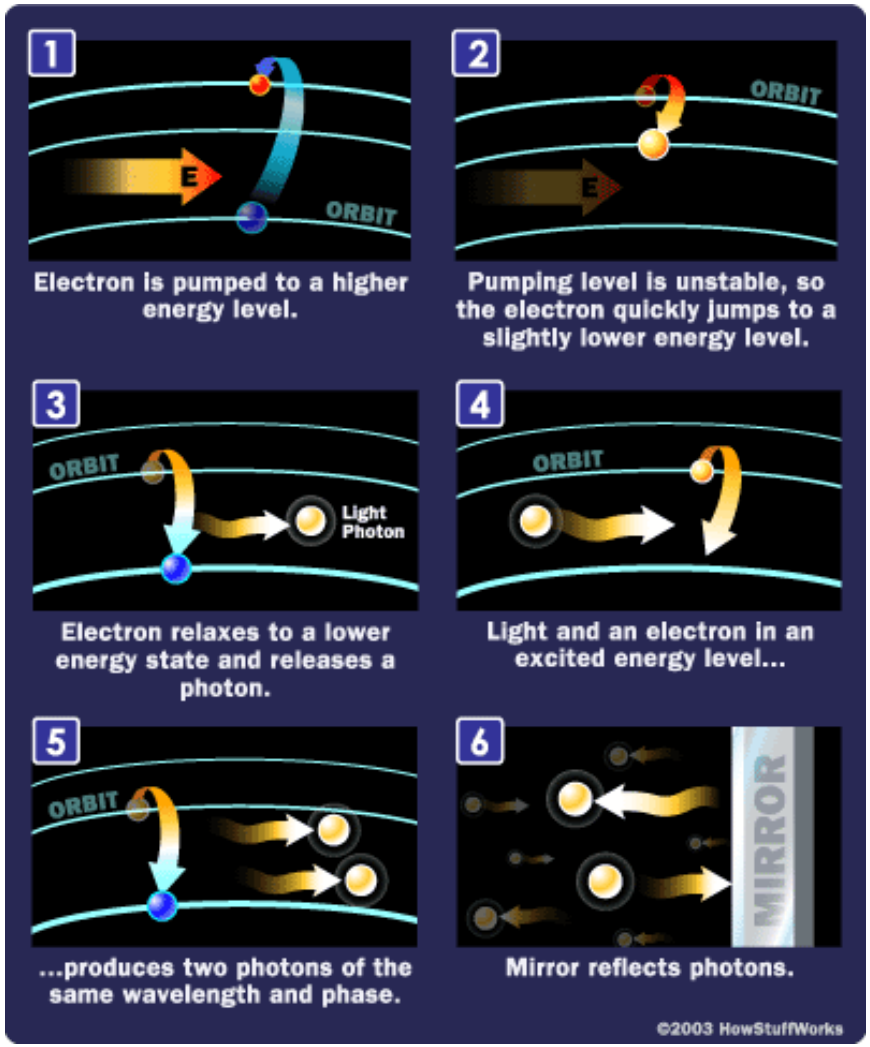
- photons in phase temporally/spatially

Collimated

- tight beam, parallel paths

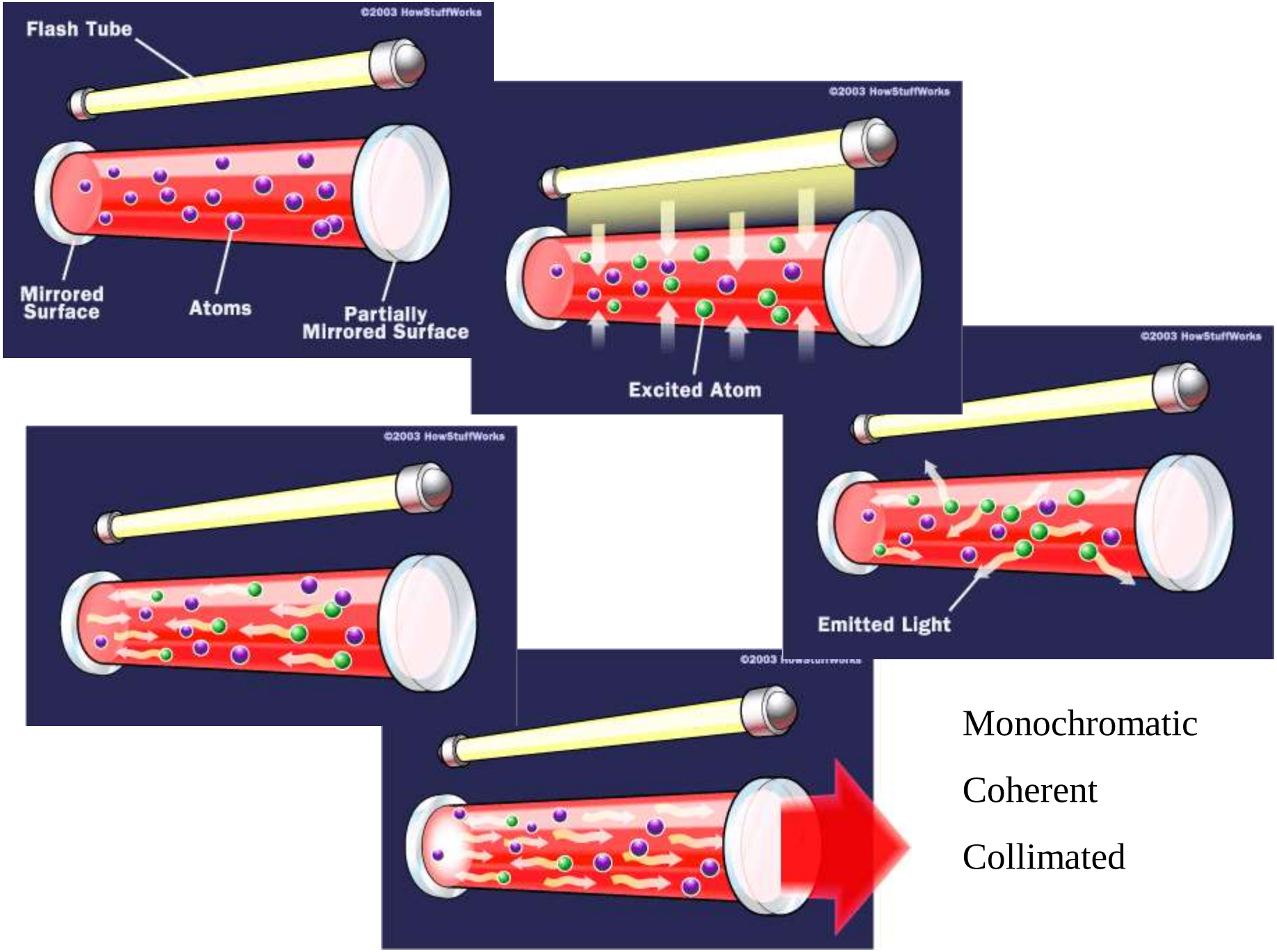
Monochromatic

- one wavelength



LASER

- In the process of lasing, the excited atom is *stimulated* to emit a photon before spontaneous emission takes place.
- A photon of right wavelength is made to enter the electromagnetic field of an atom.
- Two important points to be taken care of:
  1. Incident photon should not be absorbed.
  2. Energy of incident photon =Energy of the emitted photon.
- Therefore, selection of the wavelength of the incident photon is very crucial.



Monochromatic

Coherent

Collimated

EFFECTS ON BIOLOGICAL TISSUES

- **Laser designed for surgery, delivers concentrated and controllable energy to biological tissue.**

  warming (37 – 60^0 c)

  welding (60 – 65^0 c)

  Coagulation (65 – 90^0 c)

  protein denaturation (90 – 100^0 c)

  vaporization (>100^0 c)

laser light- tissue interaction

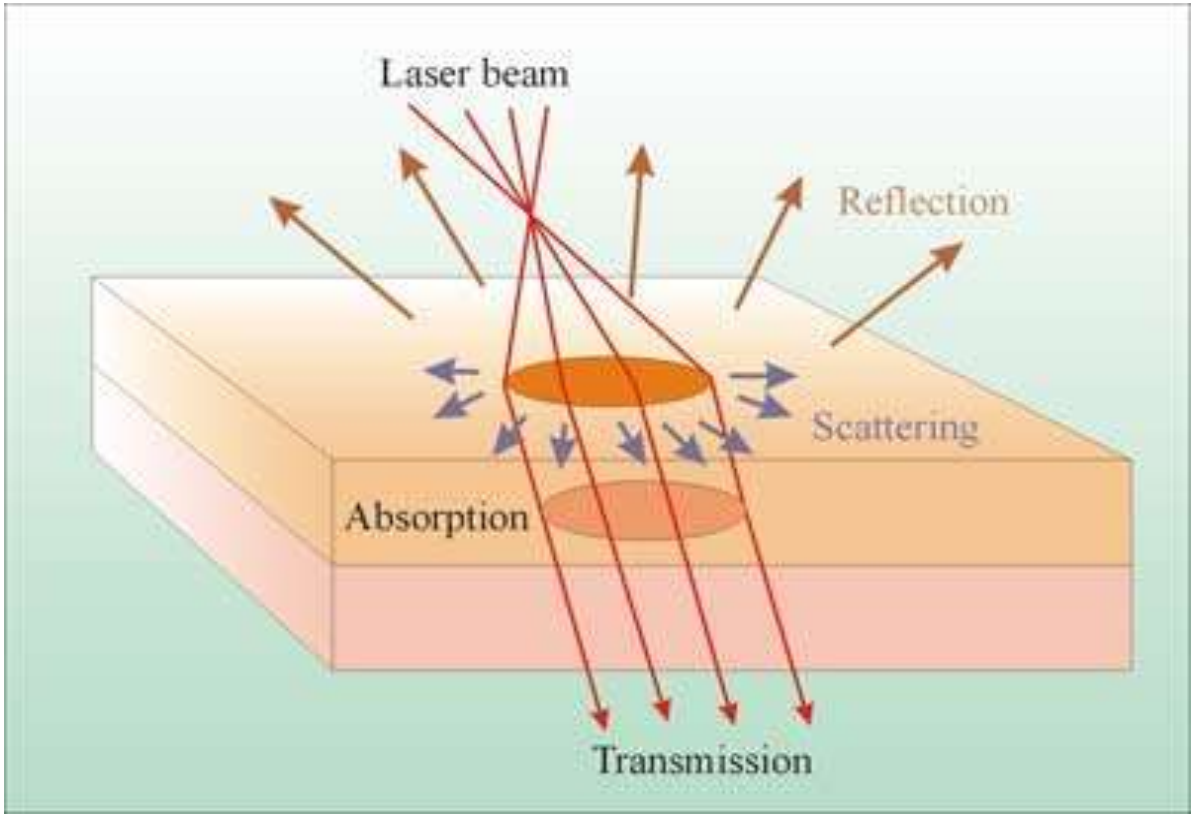
The primary characteristics of such interaction are illustrated in this fig. shows the primary physical phenomena:

Transmission

Reflection

Scattering

Absorption



LASER LIGHT- TISSUE INTERACTION

The energy is absorbed and transformed into some other forms of energy. The relative degree of these processes is dependent upon the type of tissue .

In order to define the laser light interaction with the tissue, Thus, the degree of **absorption and the extension** of this process are dependent upon:

1) The tissue structure, consent of water, haemoglobin, enamel, dentin, pulp cavity, etc.
2) The wavelength, the power, the energy dose and the irradiation time.

Radiation-tissue interaction effects:

a)photobiochemical effects

b)photothermal effects

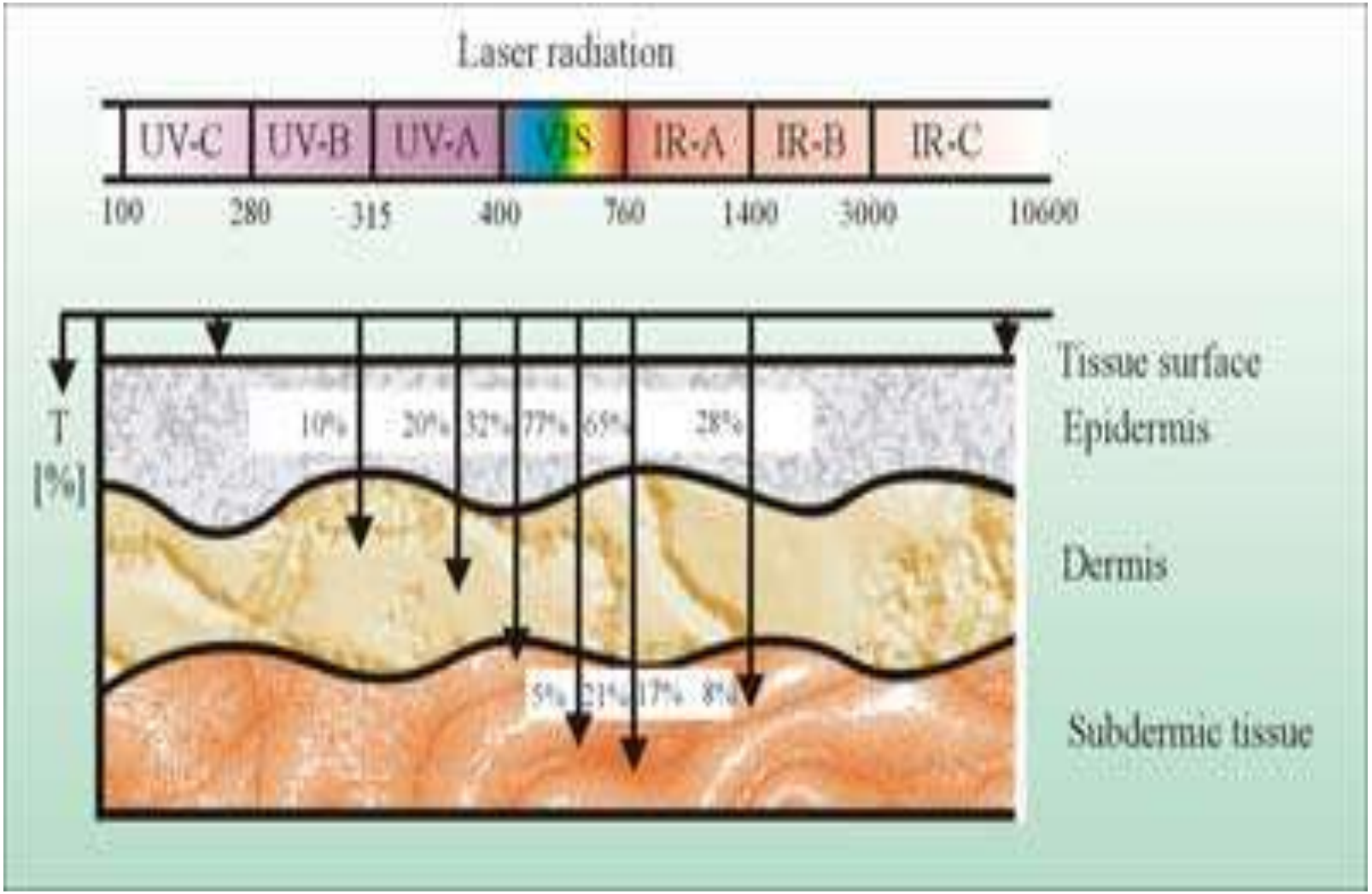
c)photoionizing effects

a) The first group involves ***photoinduction*** **(photostimulation**), ***photoresonance*** or ***photoactivation*** constituting so called biostimulation processes. ***Photochemotherapy*** is an effect of interaction connected with photodynamic therapy (PDT) .The PDT effect is applied with chemical drug called ***photosensitizers***.

b) The second group includes thermal effects. ***Optical radiation is transformed to heat*** which, depending on temperature, can be used for tissue ***coagulation, evaporation or carbonization.***

c) The third group covers non-thermal effects such as ***photoablation*** and ***photodisintegration***. The above mentioned processes and effects are presented in the Table below.

TRANSMISSION VALUES OF THE MAIN WAVELENGTHS FOR SELECTED PARTS OF SKIN.



TYPES OF LASERS

- Lasers commonly used in dentistry today are

1. Carbon-di-oxide
2. Nd: YAG (Neodymium yttrium-aluminum-garnet)
3. Erbium: YAG
4. Diode
5. Argon
6. Excimer lasers

CARBON DIOXIDE LASER

The primary advantage of CO_2 laser surgery over the scalpel is hemostasis and a relatively dry field for improved visibility

Applications

- **Gingivectomy/gingivoplasty/frenectomy**
- **Crown lengthening**
- **Biopsies**
- **Dentinal hypersensitivity(seals the dentinal tubules)**
- **Exposure of implants**
- **Treatment of apthous ulcers**
- **Tuberosity reduction**
- **Preprosthetic surgery**

NEODYMIUM: YAG LASER

Nd: YAG laser is ideal for **ablation of potentially hemorrhagic abnormal tissue,** and for **hemostasis** of small capillaries and very small venous vessels

Applications

- **Gingivectomy/gingivoplasty/frenectomy**
- **Crown lengthening**
- **Biopsies**
- **Hemostasis of the graft donor site**
- **Flap wedging after flap surgery**

  eliminating the need for sutures
- **Pocket sterilization**

ERBIUM: YAG LASER

The Er: YAG laser is ideal for absorption by hydroxyapatite and water, making it more efficient in ablating enamel and dentin than any laser.

Applications

- Cavity preparation
- Apicectomy
- Cyst removal
- Osteotomy

DIODE LASER

- It is a relatively new addition to the periodontal armamentarium.

- This energy level is absorbed by pigmentation in the soft tissues and makes the diode laser an excellent hemostatic agent.

- The affinity of the diode laser wavelength for anaerobic pathogen may be a useful method for decontaminating the surface of failing implants in peri-implantitis

ARGON LASER

The Argon laser therapy is the current treatment of choice for dermatologic, labial and oral lesions that have large vascular component

Applications

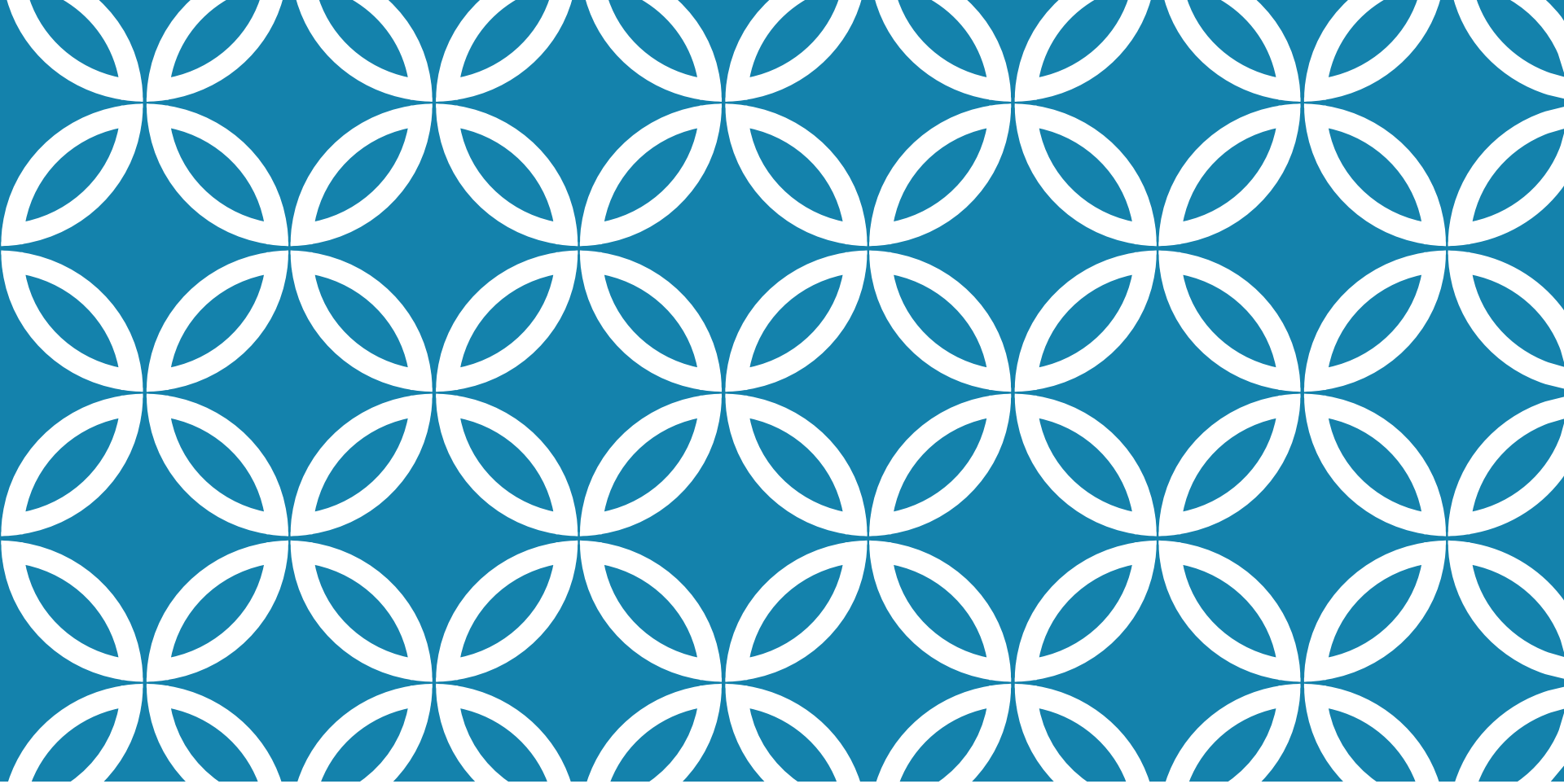
- **Gingivectomy/gingivoplasty/frenectomy**
- **Incision/excision**
- **Gingival retraction**
- **Root planing & curettage**
- **De-epithelialization**
- **Exposure of implants**
- **Proximal caries detection**
- **Photopolymerization**

EXCIMER LASER

- Currently being used extensively for caries removal has also being used for soft tissue surgery.
- It is being tried for root canal preparation.

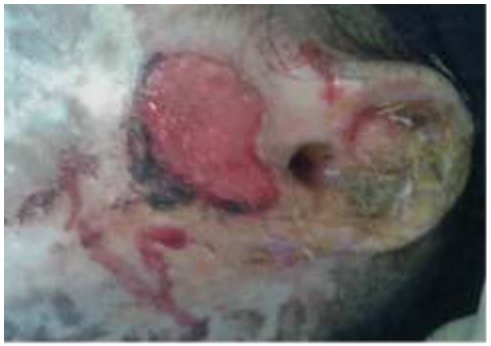
applications

- Gingivectomy/Gingivoplasty
- Frenectomy
- Removal of muco-cutaneous lesions (both benign and malignant)
- Gingival sculpting techniques associated with implant therapy and muco-gingival surgery
- Soft tissue tuberosity reduction.
- Soft tissue distal wedge procedure.
- Removal of hyperkeratotic lesions and vascular lesions (Hemangioma, Pyogenic granuloma etc).
- Depigmentation procedures.
- Pocket sterilization.



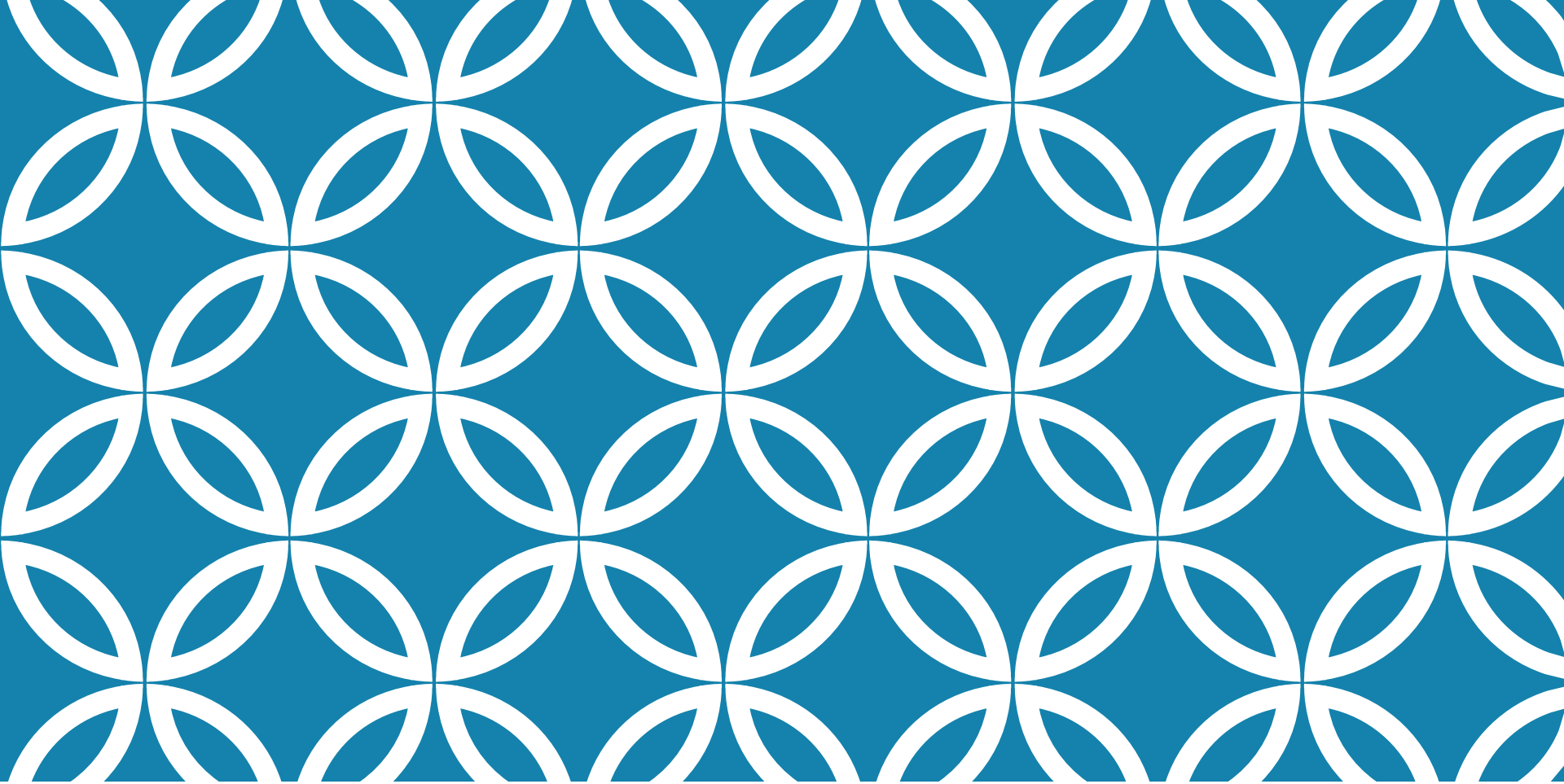
APPLICATIONS IN ORAL SURGERY

EXCISION OF A MASS



EXCISION OF MUOCOCELE

SURGICAL EXPOSURE



APPLICATIONS IN PERIODONTOLOGY

GINGIVECTOMY OF REDUNDANT GINGIVAL TISSUE ON MAXILLARY ANTERIOR TEETH

PREOPERATIVE APPEARANCE

IMMEDIATELY AFTER SURGERY

HEALING AT 7 DAYS AFTER SURGERY

GINGIVECTOMY/GINGIVOPLASTY/FRENECTOMY

PREOPERATIVE APPEARANCE

IMMEDIATELY AFTER LASING

7 DAYS AFTER LASER SURGERY

FRENECTOMY

MAXILLARY LABIAL FRENUM CAUSING PULL ON MARGINAL GINGIVA & INTERDENTAL PAPILLA

LASING OF THE FRENUM

7 DAYS AFTER SURGERY

TONGUE-TIE

PREOPERATIVE

LASING OF THE FRENUM

EIGHT WEEKS AFTER LASING

CROWN LENGTHENING

CHIEF COMPLAINT- TEETH TOO SHORT

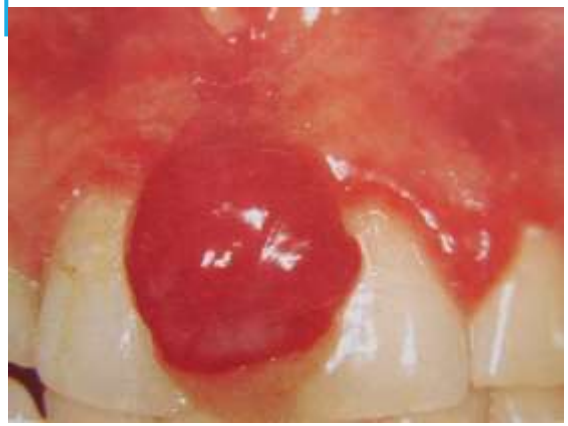
AFTER LASING OF THE LEFT HALF

AFTER COMPLETE LASING

SIX WEEKS AFTER LASER SURGERY

PYOGENIC GRANULOMA

BEFORE LASING

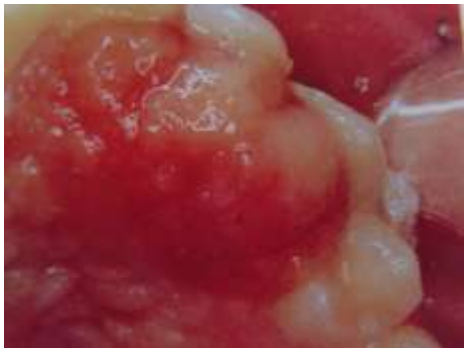


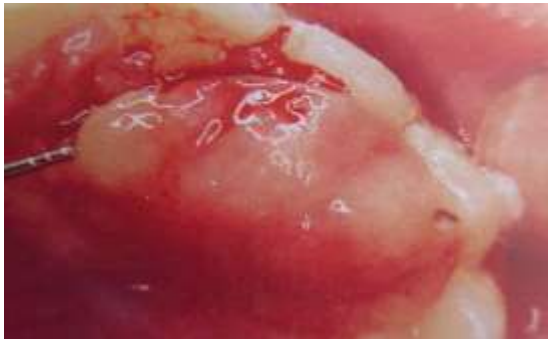
AFTER LASING

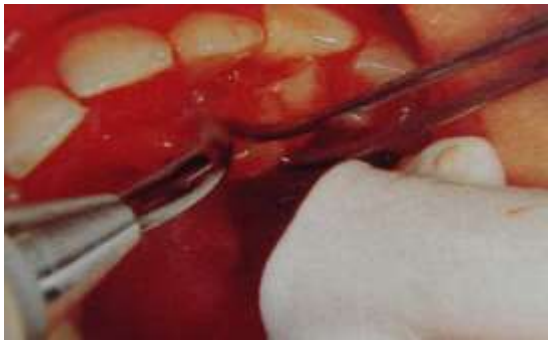
BEFORE LASING

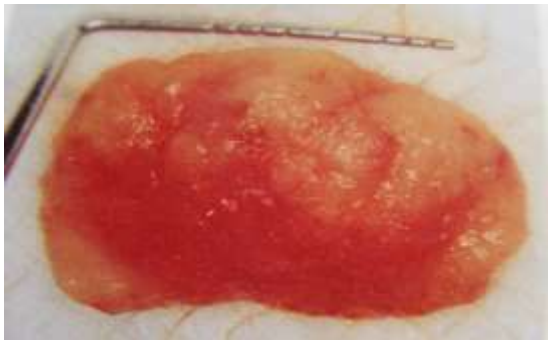
AFTER LASING

EXCISION OF A PYOGENIC GRANULOMA









PERIODONTAL POCKET STERILIZATION

HARD TISSUE APPLICATIONS

- ✓The erbium: YAG laser has demonstrated the best application of laser use directly upon hard tissue, leaving the least thermal damage and creating a surface that suggests biocompatibility for soft tissue attachment
- ✓Preliminary evidence has been reported that the lasers may be useful for treatment of dentinal hypersensitivity and bleaching.

LASERS IN IMPLANTOLOGY

- Implantology is starting to benefit from some laser applications mainly in the treatment of peri-mucositis and peri-implantitis.
- Diode lasers are, at the moment, the best instruments for the uncovering surgery, and for the treatment of peri-mucositis and peri-implantitis.

IMPLANT EXPOSURE

MANDIBULAR RIDGE FOLLOWING STAGE I HEALING PHASE.

IMPLANTS EXPOSED

EXPOSURE OF INTEGRATED IMPLANTS BY LASER

2 WEEK POST OPERATIVE APPEARANCE.

HAZARDS

OCULAR HAZARDS- can cause retinal damage & cataracts either by direct exposure or by reflection fro a mirrorlike surface.(dental instruments).

always use protective eyewear.

TISSUE HAZARDS-temperature elevations of 21° C above body temp.(37°C) can produce cell destruction by denaturation of cellular enzymes and structural proteins.

RESPIRATORY HAZARDS-After soft tissue vaporization by lasers a variety of chemicals are released (formaldehyde, cyanates,benzene,methane,acetone). These when inhaled – damage to the respiratory system.

appropriate ventilation,evacuation,use of suction etc.

COMBUSTION HAZARDS-In the presence of inflammable materials lasers may pose significant hazards.

(resins,plastics,acetone,waxes, anesthetics etc.)

ELECTRICAL HAZARDS-Can be grouped as

shock hazards

electric fire hazards

THANK YOU