

Technology in the Dental Practice

Lecture Topics

- ▶ Intraoral Cameras
- ▶ Scanners (for Orthodontics, Crown and Bridge, Implants)
- ▶ CBCT and PANO
- ▶ In-office Milling Machines (for crown and bridge)
- ▶ 3D Printers (Clear Ortho Aligners, Study Models, Surgical Guides)
- ▶ Lasers/Electrosurgery

Intraoral Cameras

- ▶ “A picture is worth a thousand words.”
- ▶ Great tool for patient education
- ▶ Can point out dental caries, cracks, gum disease, recession, staining, oral pathology, intraoperative findings
- ▶ Fantastic for documentation
- ▶ Can make a big difference in patient acceptance of dental treatment
- ▶ Many offices have intraoral cameras in their hygiene rooms
- ▶ It is wonderful when the RDH can document findings during a prophy prior to the dentist entering.
- ▶ Usually integrates with the practice management software and will save images directly into the patient’s digital record



Intraoral Cameras

- ▶ Multiple Brands (wide range in pricing: \$300-\$1,500)
- ▶ Cover Camera with a clear protective barrier while using
- ▶ Wipe down afterwards with disinfectant wipe



Intraoral Scanners

- ▶ An **intraoral scanner** is a device that is used to capture a direct optical impression. The **scanner** projects a light source onto the area to be scanned. The images are captured by imaging sensors and are processed by **scanning** software, which then produces a 3D surface model.
- ▶ The digital scan is saved as an STL file
- ▶ STL file consists of many triangles that maps the surface of an object

Carestream CS 3600 Scanner



Intraoral Scanners

- ▶ Substitute for Analogue Impressions
- ▶ Great for patients with a gag reflex
- ▶ Sent to the dental lab over the internet.
- ▶ Can save turnaround time on labwork
- ▶ In Color
- ▶ Often more accurate than an analogue impression because no distortion occurs
- ▶ Can only scan what they can see. Sometimes has difficulty capturing deep margins on crown preparations
- ▶ Often slower than an analogue impression

Intraoral Scanners Continued

- ▶ Some newer scanners have “cavity detecting” software
- ▶ Can help select tooth shades
- ▶ Some scanner tracking software can point out changes in teeth or gums that occurs over time, such as recession or tooth cracks.
- ▶ Expensive: Range from \$15,000-\$40,000 and some have ongoing operating costs
- ▶ The Itero Scanner is sold by Align Technologies (Invisalign). The Itero can do Invisalign simulations for the patient.
- ▶ Some are wireless

Other Popular Digital Scanners





Panoramic Radiograph

- ▶ Hygienists frequently take PANOs in clinical practice
- ▶ Newer Panoramic Machines have more customizable features
- ▶ Can take multiple types of images beyond standard Panoramic

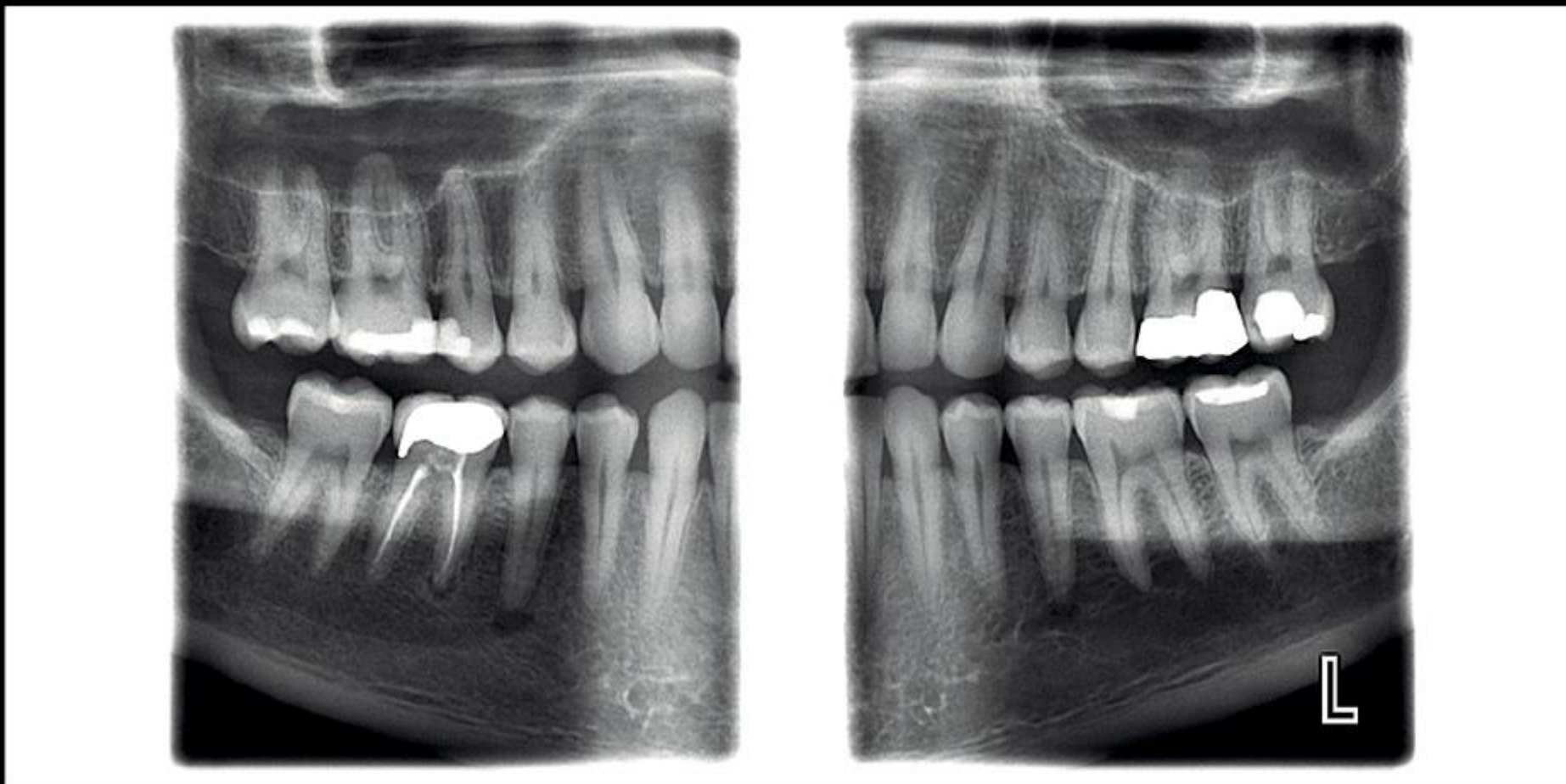
For Instance, Extraoral Bitewings:

- ▶ “Extraoral Bitewings” can be great for patients with an exaggerated gag reflex or those who cannot tolerate intraoral radiographs

Planmeca ProMax 2D S3

- ▶ Standard panoramic
- ▶ Lateral TMJ (closed & open)
- ▶ PA TMJ (closed & open)
- ▶ PA sinus
- ▶ Horizontal and vertical segmenting for panoramic program
- ▶ True Bitewing
- ▶ Child Mode for reduced radiation

True Bitewings (Extraoral Bitewing)



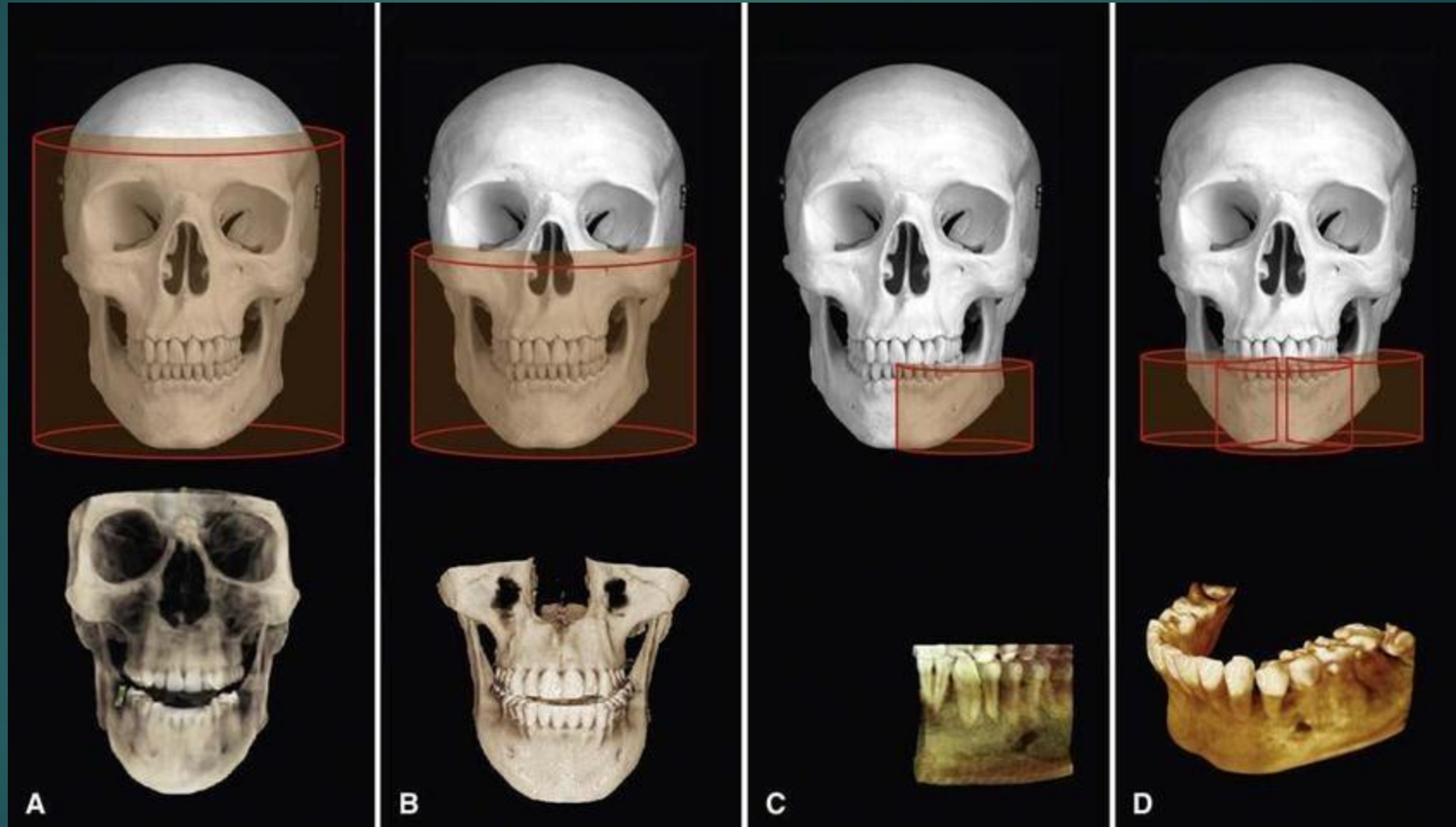
Cone Beam Computed Tomography

- ▶ CBCT has been described as the gold standard for imaging the oral and maxillofacial area
- ▶ Gives 3D images of hard tissues
- ▶ CBCTs are saved as DICOM files
- ▶ Common Uses:
 - Dental Implant Planning
 - Evaluating Pathologies
 - Evaluate proximity of 3rd Molars to IAN
 - Evaluate # of canals in endodontics
 - 3D orthodontic tooth evaluation
 - Trauma
- ▶ Hygienists often take CBCTs, just like PANOs

CBCT: Field of View

- ▶ When taking CBCTs, it is desirable to limit the field size to the smallest volume that can accommodate the region of interest
- ▶ This will assure the lowest possible amount of radiation
- ▶ Protects the dentist from liability.
- ▶ The dentist is responsible for evaluating/diagnosing anything that is captured in a PANO or CBCT. If only a small area is captured, then there is less liability.
- ▶ In general, the smaller the scan volume, the higher the resolution of the image and the lower the effective radiation dose to the patient (American Academy of Endodontics, Colleagues for Excellence Summer 2011)

CBCCT: Field of View



In Office Milling Machines

Two of the most popular brands are:

- Cerec
- Planmeca (formerly E4D)

The crown is prepared and the impression is taken with a digital scanner. The crown is designed on a computer and then sent to the milling unit for fabrication.



Zirconia Crown: Dry Mill



Lithium Disilicate Crown: Wet Mill



In Office Milling Advantages



- ▶ Allows crowns, inlays, onlays, bridges, veneers to be completed in a single visit
- ▶ No need for temporary crowns
- ▶ Can be used to mill implant surgical guides
- ▶ Gives the dentist total control of the restorative process
- ▶ It is so cool for a patient to see their crown being made in person

In Office Milling Disadvantages

- ▶ Very Expensive
- ▶ Very often the crowns are designed by the dental assistant, not the dentist
- ▶ Often cannot achieve the same esthetics as a certified ceramist
- ▶ **Although** the crown can be completed in one visit, it is a very long visit
- ▶ Can limit a dentist's choices in crown types (If you spend so much on one machine, you will not be as willing to use an outside dental lab, even if a particular case may benefit from a different type of crown)

3D Printers

- ▶ Many different 3D printers on the market
- ▶ Inexpensive compared to other dental technology (\$300-\$3,500)
- ▶ Two main types in dentistry:
 - 1) Thermofilament printers
 - 2) Resin printers
- ▶ 3D printing is an additive technology, while In-Office milling is a subtractive technology
- ▶ 3D printing is not capable of making indirect restorations that are nearly as strong or as esthetic as in-office milling

Applications of 3D Printing

- ▶ Diagnostic Models
- ▶ Models for fabrication of Clear Aligner Ortho treatment
- ▶ Surgical Guides for Implant Placement
- ▶ Occlusal Guards
- ▶ Dentures
- ▶ Temporary Crown and Bridge

Three Clinical Examples

- 1) Nightguard
- 2) Implant Surgical Guide
- 3) 3-D Printed Model for Crown Preparation

3D Printing a Night Guard for Dr. Moshman

- 1) Take a Digital Impression
- 2) Design the Nightguard on computer software
- 3) 3D Print the nightguard
- 4) Try-in

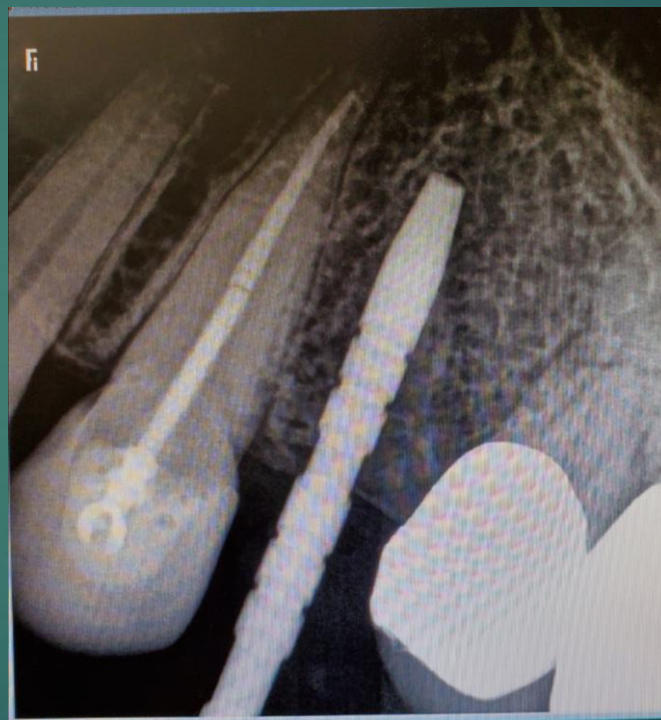
3-D Printed Nightguard



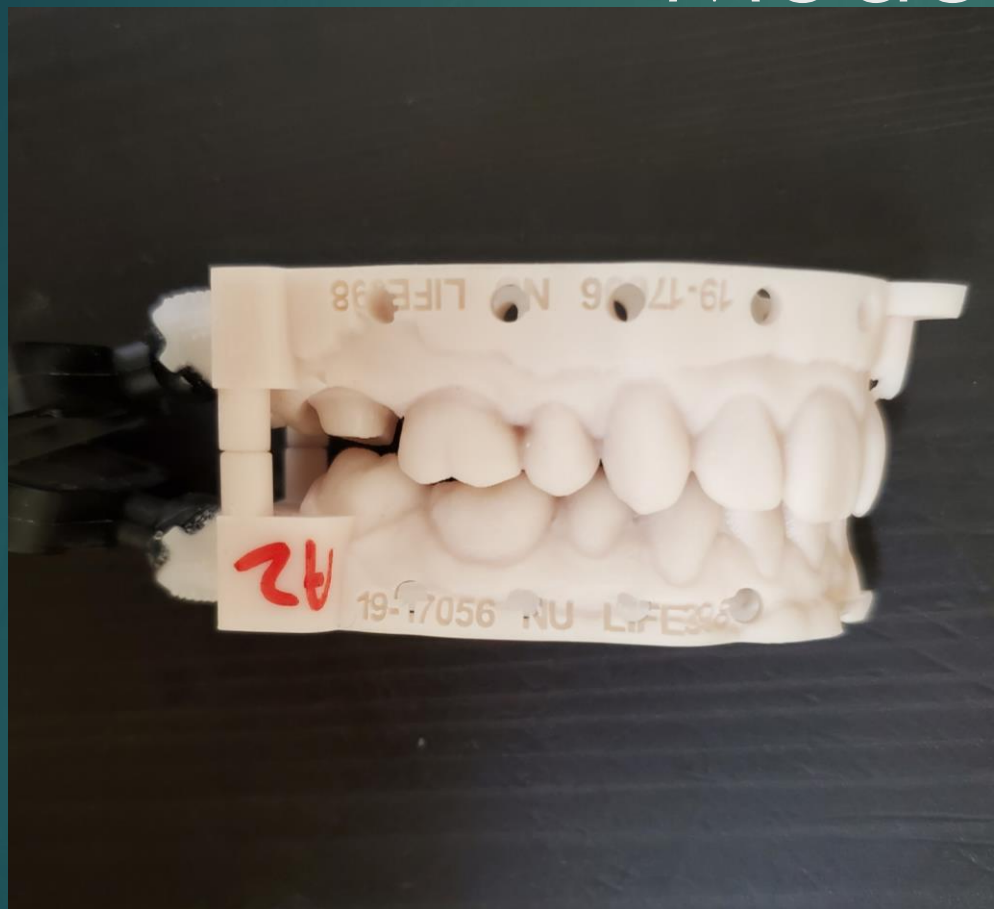
3D Printing a Surgical Guide for an Implant

- 1) Take a Digital Impression of the teeth and gums
- 2) Take a CBCT of the patient's jaw
- 3) Combine the Digital Impression and the CBCT on the computer. Plan where the implant will go and design a corresponding surgical guide
- 4) 3D Print the Surgical Guide
- 5) Verify Fit on the Model
- 6) Place the Implant

3-D Printed Implant Surgical Guide



3-D Printed Crown and Bridge Model





Dental Lasers



- ▶ Lasers have multiple applications in dentistry.
- ▶ There are multiple types of lasers
- ▶ Some treat soft tissue only, some treat soft and hard tissue
- ▶ Range from a few thousand to \$100,000.00

Lasers and Scope of Practice for the Registered Dental Hygienist

- ▶ Defined under the ADHA scope of practice guidelines for the dental hygienist, only five states allow (with written policy) a hygienist to use lasers to perform soft tissue curettage or periodontal therapy. They are Arizona, California, Colorado, Idaho, and Nevada.
- ▶ Another 17 states allow laser use but have no written policy on the matter and are Arizona, Delaware, District of Columbia, Indiana, Kentucky, Maine, Michigan, Missouri, Montana, North Dakota, Nebraska, New Mexico, **New York**, Oklahoma, Oregon, South Dakota, and Washington.

How Do Lasers Work?

- ▶ There are multiple types of lasers
- ▶ Each type of laser produces its own particular wavelength of light energy
- ▶ The particular wavelength that a laser produces is absorbed by a target tissue, or specifically the chromophore region of the molecules that make up the target tissues.
- ▶ A **chromophore** is the part of a molecule responsible for its color.
- ▶ Some lasers are absorbed by blood and tissue pigments, while others are absorbed by water as well as hard tissue, like enamel, dentin, and bone.
- ▶ This absorption process produces a thermal reaction in that tissue.

LASER = Light Amplification by Stimulated Emission of Radiation

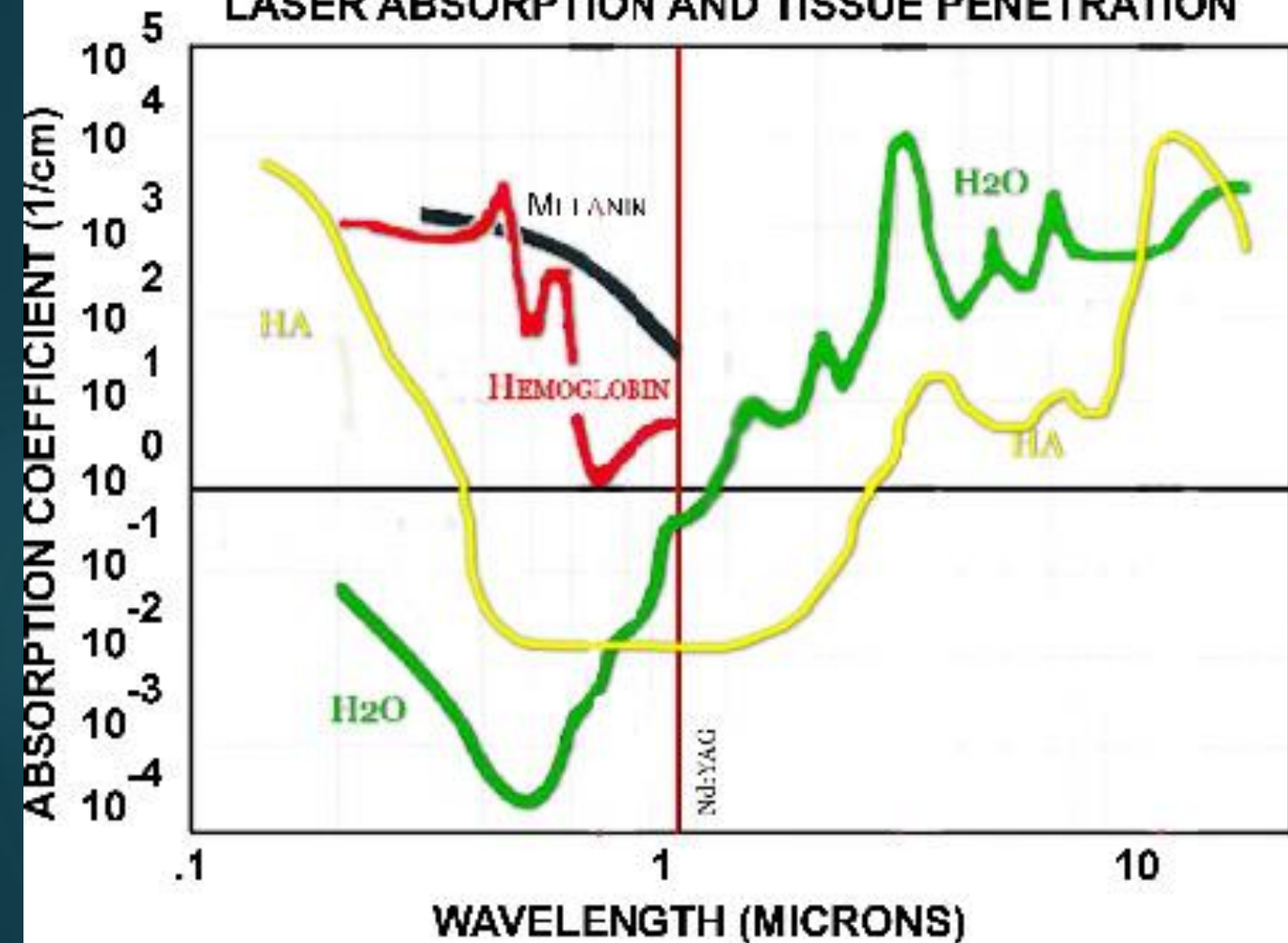
- ▶ There are 4 common laser types in dentistry: **Diode**, **Nd:YAG**, **Erbium**, and **CO2** each with a unique laser-tissue interaction based on wavelength.
- ▶ Laser types are named after the active medium – the actual component that produces the laser energy when stimulated. The 1064 Nd:YAG wavelength is produced by Neodymium-doped Yttrium Aluminum Garnet.
- ▶ Light is measured in wavelengths. Dental laser wavelengths are
 - Diodes 830-1,064nm
 - Nd:YAG 1,064nm
 - Erbium 2,790-2,940nm
 - CO2 9,300-10,600nm
- ▶ Each wavelength interacts with tissue differently: The 1064nm wavelength passes through water and Hydroxyapatite; but is absorbed in melanin and hemoglobin.

Dental Lasers Summary

- ▶ Each type of laser produces a specific wavelength
- ▶ That wavelength will target a particular chromophore.
- ▶ A chromophore is the part of a molecule responsible for its color. Examples of endogenous tissues with chromophores that absorb wavelengths found in dental lasers are hemoglobin, melanin, water, hydroxyapatite.
- ▶ Some lasers can target more than one chromophore: The Periolas (an ND:YAG laser) wavelength will target both melanin and hemoglobin
- ▶ The Solea (a type of CO2) laser targets both water and hydroxyapatite
- ▶ Other CO2 Lasers (Light Scalpel) only target soft tissue.



LASER ABSORPTION AND TISSUE PENETRATION



Wavelength

- Diodes 830-1,064nm
- Nd:YAG 1,064nm
- Erbium 2,790-2,940nm
- CO₂ 9,300-10,600nm

Benefits of Dental Lasers

- ▶ Tend to cause minimal post-operative discomfort
- ▶ Naturally cauterize and lead to hemostasis (stop bleeding)
- ▶ Some lasers can be used for tooth preparation during restorative procedures
 - ▶ (the laser allows some fillings to be done without using local anesthesia)
- ▶ Very Cool
- ▶ Can Increase Practice Revenue (especially if marketed as a laser practice)

Disadvantages of Dental Lasers

- ▶ Expensive
- ▶ Extra Safety Precautions (Eyewear for staff and patient)
- ▶ Can cause damage if not careful (ie- touching a diode laser to an implant can cause the implant to fail)
- ▶ Not recommended for biopsies as they do not leave a clean margin
- ▶ For lasers that can be used during restorative procedures:
 - ▶ Lasers do not cut teeth very efficiently and cavity preparations can take a long time
 - ▶ Lasers only shoot in a straight line. Unlike individual burs on a high-speed or low-speed handpiece, less variation in cutting action

Dental Laser Safety

- **Eye Protection** – The patient, clinical staff and any observers must wear protective eyewear specific for the wavelength being used.
- **Plume Control** – Laser procedures create a plume that may contain hazardous chemicals and microflora.
- **Sharps** – Scored laser tips of quartz fibers are considered sharps and need to be disposed of as such.
- **Warning Sign** – Warning signs need to be in a visible place and access to the operatory limited.

Diode Lasers

- ▶ Least expensive lasers in dentistry
- ▶ Works via specialized semiconductor
- ▶ Used for soft tissue only
- ▶ Gingivectomy
- ▶ Frenectomy
- ▶ Operculectomy
- ▶ Gingival Troughing for Crown Impressions
- ▶ Hemostasis and Coagulation



DIAGNOdent™ Pen by Kavo

Works via Diode Laser. From their website:

- ▶ The DIAGNOdent™ pen will show you where the decay lies. It works quickly and reliably. The laser fluorescence detector within the DIAGNOdent pen is a precise method for identifying fissure caries, proximal caries and periodontitis.
- ▶ Sub-surface caries lesions can be extremely difficult to detect using an explorer, and the DIAGNOdent™ offers a perfect adjunct to the diagnostic arsenal. It is especially useful for pit and fissure areas - even when the outer tooth surface seems to be intact.



Carbon Dioxide Lasers

- ▶ Fantastic for soft tissue use
- ▶ One Example of a CO₂ laser is the LightScalpel Laser
- ▶ From the LightScalpel Website:
 - ▶ The CO₂ laser wavelength of 10.6 micrometers is universally regarded as best suited for soft-tissue laser surgery, due to its excellent absorption by soft-tissue for both cutting/ablation and coagulation/hemostasis on the margins of the cut/ablation.
 - ▶ In contrast, the diode laser wavelength of 800–1,100 nm is extremely poorly absorbed by soft tissue (1,000 times worse than the CO₂ laser wavelength), and therefore it should NEVER be used surgically to avoid a massive spread of thermal necrosis. Diodes are used exclusively as THERMAL devices. Their hot glass tip is used similarly to electrocautery devices.
- ▶ <https://www.lightscalpel.com/products/co2-lasers/lc-1005-soft-tissue-dental-surgical-laser/>



Frenectomy with CO2 Laser



The Solea CO₂ Laser

- ▶ Operates at a different wavelength than other CO₂ laser
- ▶ Works on Soft and Hard tissue.
- ▶ Expensive!! It costs around \$100,000.00
- ▶ From the website:
 - ▶ An isotopic CO₂ dental laser, Solea uses an oxygen-18 isotope and other specialized modifications to release a 9.3 μm wavelength, unlike erbium dental lasers that vaporize water and slowly chip away at enamel and native CO₂ systems that, at a wavelength of 10.6 μm, are only useful when working on soft tissue. With such a unique wavelength, the peak level of hydroxyapatite (more or less enamel) absorption is reached and the patient's actual tooth enamel is vaporized: this is one significant differentiating factor of the Solea dental laser, and is the reason for its speed and precision.
- ▶ <http://www.convergentdental.com/science-behind-solea-dental-laser/>

The Solea CO2 Laser

- ▶ Works on soft and hard tissue
- ▶ Can use to prep teeth for fillings
- ▶ Claims to not need anesthesia when working on teeth



LiteTouch™ - All-Tissue Dental Laser

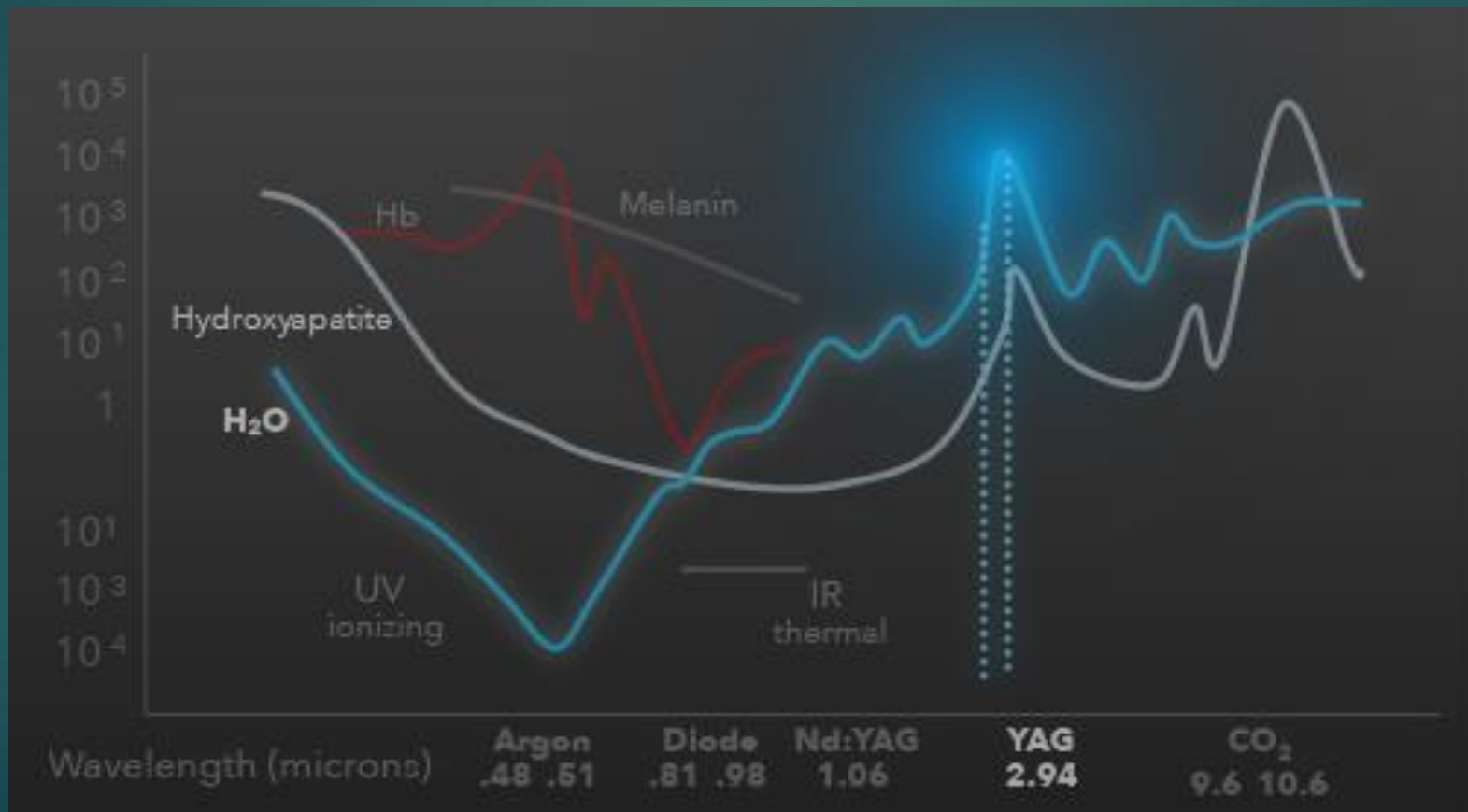
- ▶ Erbium Laser
- ▶ From the Website:

The LiteTouch™ Er:YAG Dental Laser 2,940nm wavelength, is optimally absorbed in water and highly absorbed in hydroxyapatite which are the two main chromophores in the Dentin, Enamel, Bone and Soft tissue. With these excellent absorption characteristics, LiteTouch™ Er:YAG easily ablates, cuts and decontaminates **hard and soft** tissues and is used in all specialties in dentistry.

https://www.light-inst.com/litetouch_features/



The LiteTouch™ Er:YAG Dental Laser 2,940nm wavelength, is optimally absorbed in water and highly absorbed in hydroxyapatite

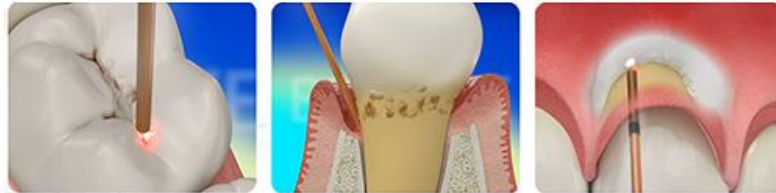


The Waterlase Express

- ▶ Another Erbium Laser
- ▶ Works on Soft and Hard Tissue
- ▶ Very Popular.
- ▶ Mid-Range laser: about \$40,000.00
- ▶ Wavelength $2.78 \mu\text{m}$ (2780nm)



EASY. PORTABLE. AFFORDABLE.



Introducing **Waterlase**
express[™]

PerioLase MVP-7 (LANAP Laser)

- ▶ Another very expensive, very popular laser
- ▶ Nd:YAG laser (neodymium-doped yttrium aluminum garnet)
- ▶ Used for LANAP Protocol = Laser Assisted Regeneration (LAR)
- ▶ Claims to be excellent for periodontal soft and hard tissue regeneration.



Procedure Controlled Menu
Appropriate parameters pre-set for 20 procedures, just touch and go for clinical application

Android touch-screen
Simple, intuitive design

Mandatory Hands-On Clinical Training
Absolutely the best laser training with CE

Re-bendable cannula
Easier access to distal areas

Ergonomic Display
Rotates 360(degree) for optimal viewing anywhere in the operatory

TrueFlex handpiece
Light, balanced design for comfort

Built for Patient Safety
Continuous display of total energy delivered to help you maintain biological tolerance

FiberFlex delivery system
Lightweight yet durable, FiberFlex fiber reduces strain and increases maneuverability

Multi-Variable Pulsed (MVP-7)
Better control laser-tissue interaction with 7 different pulse durations for maximum control over hemostasis

Power Meter
Unique safety feature to ensure power output matches device settings.

Compact Size with Small Footprint
Easily wheel between operatories

Long Pulse Width
Best for rapid homeostasis (not charring) to alter granulation tissue

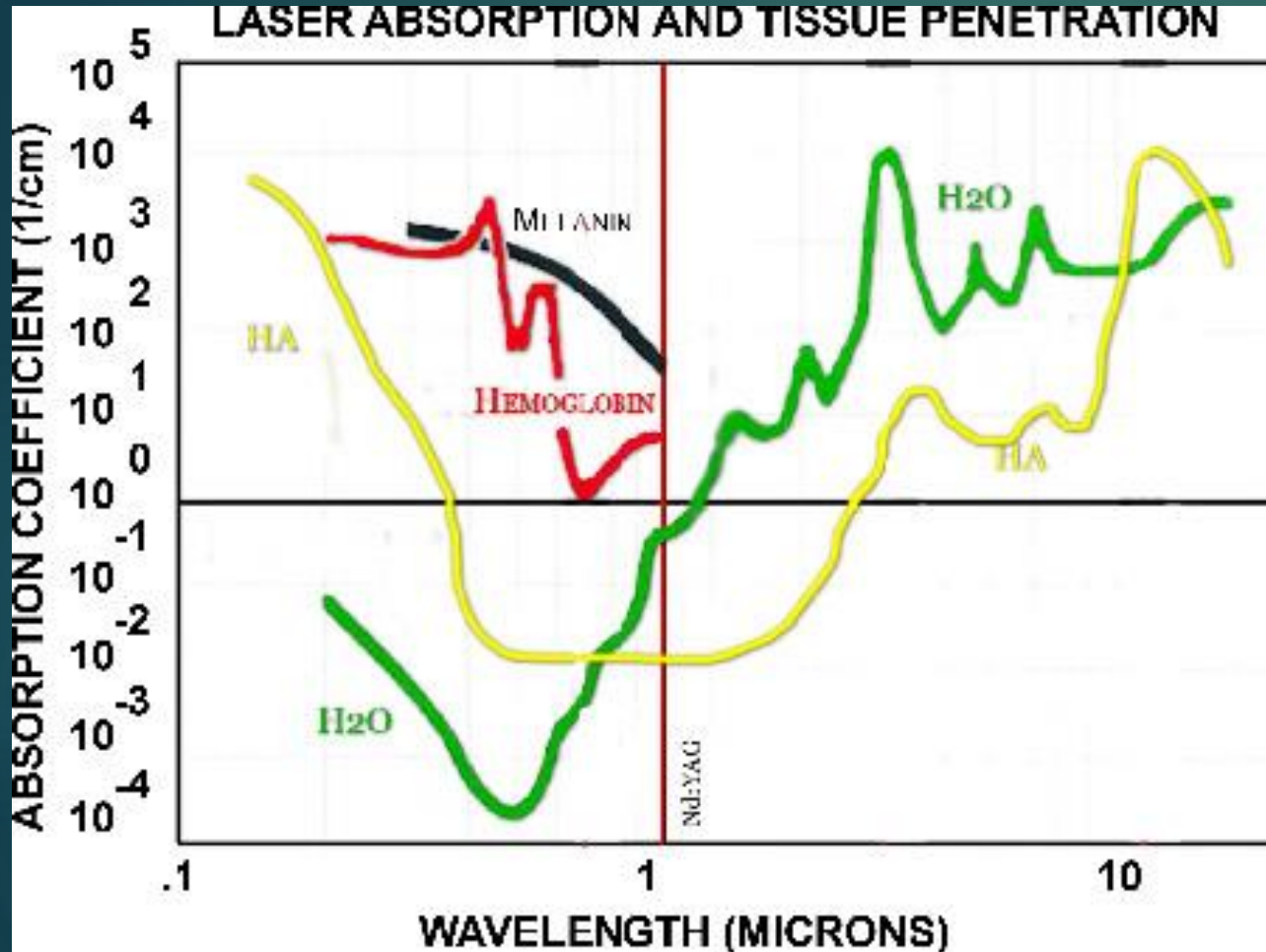
Designed by Clinicians
The features you need, optimized for actual performance

Short Pulse Width
Ideal for cutting fibrous tissue

No Special Power Requirements
Avoid costly office modifications

Beta

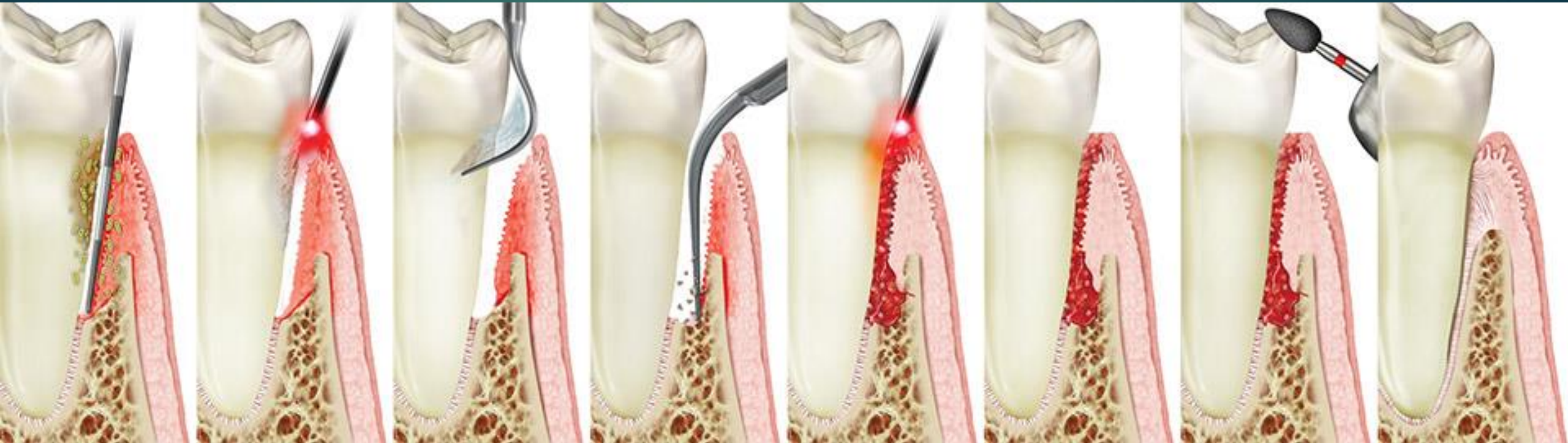
PerioLase MVP-7 is an Nd:YAG dental laser.



The 1064 wavelength passes through water and hydroxyapatite; but is absorbed in melanin and hemoglobin.

Simply put – the wavelength targets the diseased tissue without harming healthy tissue. The laser light penetrates 4mm beyond the tissue surface for effective bacteria kill.

The LANAP protocol for periodontitis

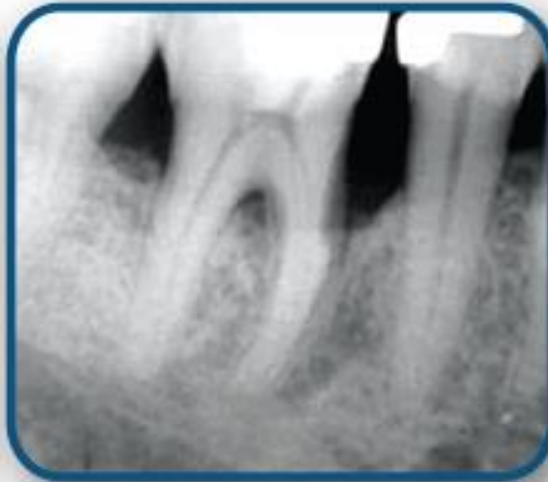


Clinical Case (On the LANAP Website)

PRE-OP



1 YEARS POST



3 YEARS POST



6 YEARS POST



R. H. Gregg, DDS, Cerritos, CA - General Dentist

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Electrosurgery

- ▶ **Electrosurgery** is the application of a high-frequency (radio frequency) alternating polarity, electrical current to biological tissue as a means to cut, coagulate, desiccate, or fulgurate tissue.
- ▶ Very Inexpensive with lower on-going costs than lasers
- ▶ Fantastic for cutting soft tissue and for coagulation
- ▶ Compared to lasers, requires more anesthetic
- ▶ Must “ground” the patient
- ▶ Must avoid toughing metal
 - ▶ ie- amalgams, metal crowns – can overheat the tooth and cause pulpal necrosis
 - ▶ Dental implants – can cause implant failure (just like a diode laser)



Role of the Dental Hygienist

- ▶ An RDH degree gives far more opportunity than just clinical practice
- ▶ Can be hired as a consultant
- ▶ Can go into academia
- ▶ Can lecture or teach continuing education
- ▶ Knowledge of various dental technologies can lead to new opportunities!
- ▶ Many dentists are now utilize these various technologies and will have their hygienists perform digital scanning, take CBCTs or even design appliances for 3D printing.
- ▶ Hygienists can use lasers for perio therapy

THANK YOU!!

