1. Laser Safety
   - Safety
   - Efficiency
   - Proper use
   - Knowing the mistakes
   - Infection Control
   - Electrocautery
   - Plume

2. Disclaimer
   - ADA
   - AAOMP
   - ABOMP
   - Univ. of Iowa
   - Expert testimony

3. For Plume Issues
   PLEASE PLEASE Go to www.aorn.org

4. General Outline
   A. General Laser Safety in the Dental Office
      - Types of lasers/classification
        - Optical hazards
          - Area control
          - Glasses
   B. Smoke Plume Safety (both lasers and electrocautery)
      - OSHA, NIOSH, ANSI etc. standards
      - Equipment and facility requirements
        - open bay?, filters, evacuation, venting
      - Personal protection equipment for staff
        - Eye safety
        - Respiratory safety
        - Infection control
   C. Tissue diagnostics (both lasers and electrocautery)

5. Laser Safety Training
   For more information refer to the department Laser Safety Procedure

6. Definition & Properties of Laser Light
   Acronym For:

7. Types of Lasers by kind of Lasing Media
   Lasers are often described by the kind of lasing medium they use - solid state, gas, excimer, dye, or semiconductor.
Solid state lasers have lasing material distributed in a solid matrix, e.g., the ruby or neodymium-YAG (yttrium aluminum garnet) lasers. The neodymium-YAG laser emits infrared light at 1.064 micrometers.

Gas lasers (helium and helium-neon, HeNe, are the most common gas lasers) have a primary output of a visible red light. CO2 lasers emit energy in the far-infrared, 10.6 micrometers, and are used for cutting hard materials.

Excimer lasers (the name is derived from the terms excited and dimers) use reactive gases such as chlorine and fluorine mixed with inert gases such as argon, krypton, or xenon. When electrically stimulated, a pseudomolecule or dimer is produced and when lased, produces light in the ultraviolet range.

Types of Lasers by Duration of LASER Emission

Lasers are also characterized by the duration of laser emission, continuous wave or pulsed laser.

Q-Switched laser is a pulsed laser which contains a shutter-like device that does not allow emission of laser light until opened. Energy is built-up in a Q-Switched laser and released by opening the device to produce a single, intense laser pulse.

Continuous Wave (CW) lasers operate with a stable average beam power. In most higher power systems, one is able to adjust the power. In low power gas lasers, such as HeNe, the power level is fixed by design and performance usually degrades with long term use.

Single Pulsed (normal mode) lasers generally have pulse durations of a few hundred microseconds to a few milliseconds. This mode of operation is sometimes referred to as long pulse or normal mode.

Types of Lasers by kind of Lasing Media

Dye lasers use complex organic dyes like rhodamine 6G in liquid solution or suspension as lasing media. They are tunable over a broad range of wavelengths.

Semiconductor lasers sometimes called diode lasers, are not solid-state lasers. These electronic devices are generally very small and use low power. They may be built into larger arrays, e.g., the writing source in some laser printers or compact disk players.

Hazard Assessment

Responsibilities

The laser lab Principal Investigator has the Laser Safety Officer responsibilities for their lab.

The laser worker is one who operates or works in proximity to Class 3b or Class 4 lasers.

John Hellstein DDS, MS

2014 Annual Symposium
He/she has the following responsibilities:

To participate in laser safety training.

To be familiar with all operational procedures and specific safety hazards of the Class 3b or Class 4 laser/laser systems that he/she will operate.

To operate Class 3b and Class 4 laser/laser systems safely and in a manner consistent with safe laser practices, requirements and written SOPs.

To operate Class 3b and Class 4 laser/laser systems only under the conditions authorized by the laser principal investigator.

To report all unsafe conditions, known or suspected accidents to the principal investigator.

To report to the laser principal investigator any medical conditions that could cause him/her to be at increased risk for chronic exposure.

Summary of Engineering Controls

Summary of Administrative Controls

Optical Radiation: Lasers

Workers with exposure to laser beams must be furnished suitable laser safety goggles which will:

1. Protect for the specific wavelength of the laser.
2. Be of optical density adequate for the energy involved.

[1926.102(b)(2)]

OSHA

General Duty Clause:

NIOSH/CDC: Work Practices

The smoke evacuator or room suction hose nozzle inlet must be kept within 2 inches of the surgical site.

The smoke evacuator should be ON (activated) at all times when airborne particles are produced.

Follow Standard Precautions.

OSHA: General Industry (29 CFR 1910)

– 1910 Subpart I, Personal protective equipment
– 1910.134, Respiratory protection. Paragraph (a)(1) states the primary objective is to control occupational diseases caused by breathing air contaminated with harmful substances. This is to be accomplished through accepted engineering controls if feasible, or through the use of appropriate respirators. Note: Surgical masks used to prevent contamination of the patient are not certified for respiratory protection of medical employees.

1910 Subpart Z, Toxic and hazardous substances [related topic page]

OSHA: General Industry (29 CFR 1910)

1910.1030, Bloodborne pathogens. Paragraph (d)(3)(i) states the employer must supply appropriate personal protective equipment such as gloves, gowns, masks and eye protection. This standard would apply if such items become contaminated with viable bloodborne pathogens from laser smoke or plume.

John Hellstein DDS, MS  
2014 Annual Symposium
During surgical procedures that use a laser or electrosurgical unit, the thermal destruction of tissue creates a smoke byproduct. Each year, an estimated 500,000 workers, including surgeons, nurses, anesthesiologists, and surgical technologists, are exposed to laser or electrosurgical smoke.

Although there has been no documented transmission of infectious disease through surgical smoke, the potential for generating infectious viral fragments, particularly following treatment of venereal warts, may exist.

Surgical plumes have contents similar to other smoke plumes, including carbon monoxide, polyaromatic hydrocarbons, and a variety of trace toxic gases.

As such, they can produce upper respiratory irritation, and have in-vitro mutagenic potential.

OSHA Respiratory Protection

Recognizes:
Lasers and electrosurgical plume contain toxic, mutagenic, and carcinogenic elements

Mandates and Identifies:
Removal of atmospheric contaminants with acceptable engineering controls, local ventilation, including smoke evacuation systems

ANSI Z136.3-2011

Plume. Gases, vapors and aerosol created by vaporization of tissue or other materials and may contain viable bacteria, viruses, cellular debris or noxious fumes.

Personal protective equipment (PPE). Personal safety protective devices used to mitigate hazards associated with laser use, e.g., laser eye protection (LEP), and biologic hazards for infection control, e.g., protective gowns, clothing, masks and gloves.

Yes the mask matters!!!

Off of FDA device clearance form

WRONG!!! In my opinion

Secondary herpes

Primary herpes

LASERS will not help primary herpes

Herpes AND HIV

Condylomata

Condyloma

Not nearly as clear-cut that you are dealing with a condyloma. Most people would’ve thought HPV but probably more common wart or papilloma.

HPV types
Common warts
– 2, 4, 7, 22
Oral papillomas
– 6, 7, 11, 16
Oral pharyngeal cancers
– 16, 18, 31 etc.
Oropharyngeal/airway papillomatosis
– 6, 11
Focal epithelial hyperplasia (Heck’s disease)
– 13, 32

But if you already know that it is HPV related by its appearance. Why would you utilize something that is going to create a potentially infectious plume?

Now I want to stress very strenuously that I don’t believe that the laser plume has ever been associated with an evolving oral cancer. But...

BEST PRACTICE

Despite the ability to disperse HPV DNA in laser plume, the evidence suggests that the risk of transmittal of HPV to surgeons and the development of clinically active infection appears to be low. Commercially available filters and masks for use in laser surgery will not afford protection against exposure to HPV, but evacuation of plume from the surgical field is likely an effective strategy to prevent viral contamination. As the use of office-based laser systems and transoral laser procedures increases, the risk to personnel and patients will require more scrutiny.

LEVEL OF EVIDENCE
– This study comprises three level 1 studies, one level 3 study, and one level 4 study.

ANSI Standard 7.4 of Z136.3 - 2011
(Safe Use of Lasers in Healthcare)
Airborne Contaminants:
Shall be controlled by the use of ventilation (ie., smoke evacuator). Respiratory protection for any residual plume escaping capture.

ANSI Standard 7.4 of Z136.3 - 2011
(Safe Use of Lasers in Healthcare)
Personnel operating the laser should have no other responsibilities other than operation of the laser.
– Someone else needs to operate the suction
– Someone else needs to control the area
– Etc.
–
–

ANSI Standard 7.4 of Z136.3 - 2011
(Safe Use of Lasers in Healthcare)

LGAC, also referred to as laser plume, consisting of smoke, vapor and airborne particles (carbonized tissue, blood, potential bacteria and virus) is the by-product of tissue vaporization or interaction with various materials. Tissue carbonization, a biological tissue change resulting from vaporization, is a major factor in the production of plume.

Viral sizes
Human Immunodeficiency Virus 0.15 μm
Human Papillomavirus 0.055 μm
Hepatitis B 0.042 μm
But could be Filtered if in H2O

Instances where masks do help
• Tobacco Smoke 0.1-3.0 μm
• Surgical Smoke 0.1-5.0 μm
• Bacteria 0.3-15.0 μm
• Lung Damaging Dust 0.5-5.0 μm
• Smallest Visible Particle 20 μm

ANSI Standard 7.4 of Z136.3 - 2011
(Safe Use of Lasers in Healthcare)

LGAC are a source of continuing concern for operating room personnel. Reduction of exposure by everyone in the procedure room should be reduced by implementation of a variety of engineering controls. Evacuation of plume to limit exposure to LGAC is the most important line of defense. Irrigation, wet sponges or minimal curettage can be used to remove charred tissue.

The plume escaping into the air must be minimized. Collection of plume should be as close to the point of evolution as possible. Minimal laser plume, if any, is generated in a fluid environment.
– Recommendation is less than 2 inches

ANSI Standard 7.4 of Z136.3 - 2011
(Safe Use of Lasers in Healthcare)

CII.2 Safety Precautions. In dentistry, safe procedures are maintained by utilizing the minimum energy density (J/cm2) and interaction time necessary to reach the treatment objective.

Conventional dental high volume or slow speed evacuation is utilized for removal of LGACs.
Some dental laser devices utilize air and water spray to reduce thermal effects to adjacent tissues.

ANSI Standard 7.4 of Z136.3 - 2011
(Safe Use of Lasers in Healthcare)

- High efficiency filtration masks with a filtering capacity of particulate matter of 0.1 µm in size should be worn by team members during any procedure to decrease inhalation of particulate matter that irritates the respiratory tract. Masks are available to more effectively filter plume, but are not to be considered adequate protection. Masks are intended for patient protection from contamination from the HCP.

ANSI Standard 7.4 of Z136.3 - 2011
AORN Electrosurgery

- "Evacuate smoke with a smoke evacuation system in open procedures
- Use standard precautions and dispose of smoke evacuator filters, tubing and wands (considered as potentially infectious waste)
- Used smoke evacuator filters, tubing, and wands should be disposed of as potentially infectious waste following standard precautions"


AORN Recommendations: Laser

RP. V "Potential hazards associated with surgical smoke generated in the laser practice setting should be identified and safe practices established."


AORN Recognizes Surgical Smoke is Hazardous

- Wear appropriate PPE
- Remove smoke with an evacuation system for open procedures and MIS procedures
- Place capture device close to the source of the smoke
- Use evacuation system according to manufacturer’s written instructions for use

Laser Safety Glasses

- When all other protective measures fail, wearing proper laser safety glasses for the wavelength and power of the laser will protect your eyes.
- Wear these glasses whenever there is a possibility of exposure to laser light above the MPE
- Different protective lenses should be used for different wavelengths

The first thing to take into account when choosing safety glasses is WAVELENGTH
In certain applications, as in the use of powerful Class IV lasers, certain protective lenses are not meant as a permanent protective shield. For example, in the use of Class IV CO2 lasers @ 10,600 nm, the protective lens only provides sufficient protection to allow immediate movement away from the beam. If the operator remains in the path of the beam, the beam will burn through the lens very quickly.

61 year old man
- Patient presents with keratotic change of vermilion.

Differential Diagnosis
- List
  - 1
  - 2
  - 3
  - 4
  - 5
- Diagnostic management
  - Medical
  - Labs
  - Anesthesia
    - Clinic
    - OR
  - Biopsy
    - Incisonal
    - Excisional

Treatment Options
- Therapeutic management
  - Laser only appropriate if not dysplastic.
  - Need scalpel confirmation
  - Some sampling risk if decision made to ablate residual keratosis

47 year-old
- Sampled previously no dysplasia

Previous lesion that was biopsied

Post-biopsy

Before ablation is OK
- Note:
  - NO MASS
  - NO ULCERATION
  - NO PROLIFERATION
  - Known RECENT Dx
- Otherwise:
  - MUST Excise and submit
soft tissue fragment measuring 0.8 x 0.3 x 0.2 cm

Don’t believe 6 cell destruction
Top and bottom destruction
Lots of artifact and bad aim
Worse: these specks are amalgam
Deep enough but probably did not get all the lesion
Loss of epithelium
Intended excision
But can’t clear margin due to laser effect
But can’t clear margin due to laser effect
Don’t be this guy/gal!!!
It was Squamous Cell Carcinoma
Loss of ability to find tissue plane
Condyloma
Think about it
Radiopacity noted on cheek

Differential Diagnosis
List
- 1
- 2
- 3
- 4
- 5
Diagnostic management
- Medical
- Labs
- Anesthesia
  Clinic
  OR
- Biopsy
  Incisional
  Excisional
Patient: 21-year-old female

Medical History and Physical Exam:
- Alert, normally developed, in no distress
- Takes Claritin for seasonal allergies and occasionally uses albuterol and Serevent inhalers for asthma
- Mononucleosis 8 years ago
- Tonsillectomy in childhood
- Denies medication allergies and all other past and present systemic conditions

Clinical Findings:
- No palpable lymphadenopathy or other abnormalities on extraoral head and neck examination
- Major salivary glands normal to palpation and normal amount of clear saliva
- Multiple ulcerations on the labial mucosa, soft palate, buccal mucosa, lateral borders and tip of tongue
- Intraoral examination otherwise normal

Think about it
- No more than 6 per year
- You are marrying the patient
  - At beck and call
- Can’t treat major cases
- Better know the difference between herpes and aphthous

24 yo male

HPI: The patient complains of a mass on the lower lip. Patient states this started in November since that time the lesion has changed in size repeatedly but not gone away.

PMH/PSH: Distant hx of exercise related asthma 3) s/p knee surgery 5 years ago
- Allergies: 1) Codeine 2) Reglan
- Meds: None

Differential Diagnosis

1. List
   - 1
   - 2
   - 3
   - 4
   - 5

2. Diagnostic management
– Medical
– Labs
– Anesthesia
  • Clinic
  • OR
– Biopsy
  • Incisional
  • Excisional

106 Diagnosis??

107 Treatment Options
  • Therapeutic management
    – Get underlying glands
    – Avoid nerves

109 Thank You