



Slide 1 - start course

Slide notes: Module III

Laser Safety

This module is concerning practical point for using lasers in dentistry with safety precaution and high efficacy.

Pleas click begin to start the module



Slide 2 – Learning Objectives

Slide notes: After study this module, you will be able to

identify laser hazard

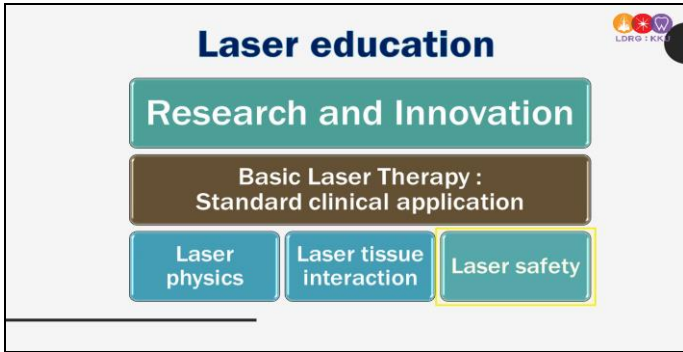
and listing laser safety protocol

Please click next button to move on to the contents



Slide 3 - Introduction

Slide notes: The benefits of lasers in dentistry are maximized when they can be used safely. Avoiding accidents that can occur to patients and medical personnel



Slide 4 - Laser education and laser safety

Slide notes: Laser safety is one of the fundamental subjects in laser education.

This links between basic laser physics and tissue interaction with clinical application.



Slide 5 - Factors related to laser safety

Slide notes: In this module, we examine the principles and components of laser safety.

The components of laser safety comprise of

the laser machine,

environmental management,

and personnel management.

Click to the detail of each component on the number

After you study all component factors, please click to go to final evaluation



Slide 6 - Factors related to laser safety

Slide notes:

Click to the detail of each component on the number

After you study all component factors, please click to go to final evaluation



Slide 7 - Laser machine

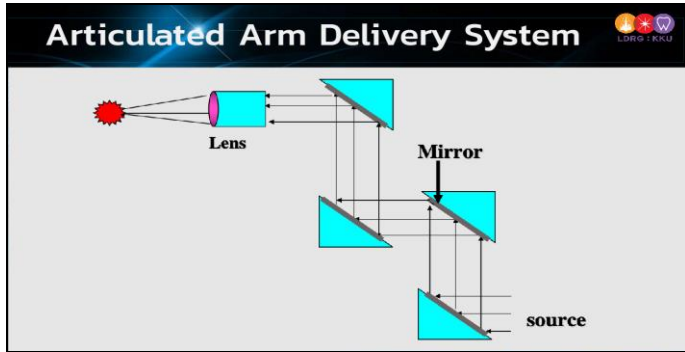
Slide notes: You knew from the module II laser physics and laser- tissue interaction that the laser machine is named by the name of laser medium such as

CO2 laser from Carbon dioxide gas

Nd YAG laser and Erbium YAG laser are from the solid state of elements

Diode lasers are from induced electrical semiconductors, that why their wavelengths are varied.

In the view of laser safety, you also need to know the laser delivery system as follows:-



Slide 8 - Articulated Arm Delivery System

Slide notes: The articulated arm:

This uses a metallic tube to conduct light from the source by the mirrors inside the tube for deflection.

This type of system loses only a small amount of energy and is durable, since it can be used until the internal mirrors are damaged.

This system also saves cost since consumable parts are not used.



Slide 9 - CO2 laser and Erbium YAG laser

Slide notes: The examples of articulated arm laser delivery as followed:-

Carbon dioxide laser - Has a wavelength of 10.6 microns which is outside the visible spectrum, therefore a light guide is used to indicate the position of the laser.

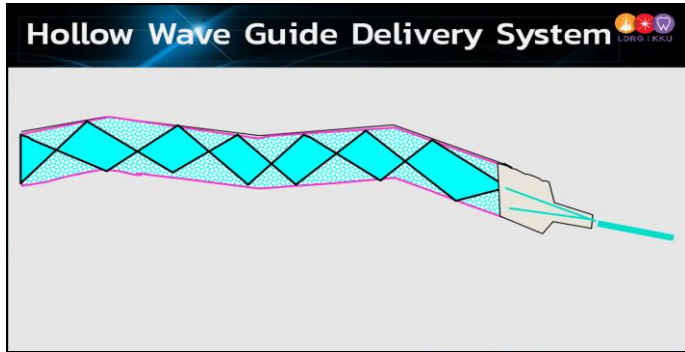
Erbium YAG laser - Has a wavelength of 2,940 nanometers. It was designed for dentistry, especially tooth preparation.



Slide 10 - Erbium YAG hanpiece

Slide notes: The handpiece of erbium YAG laser is designed to resemble a conventional dental handpiece and uses a tip made from quartz or sapphire which comes into contact with tissue.

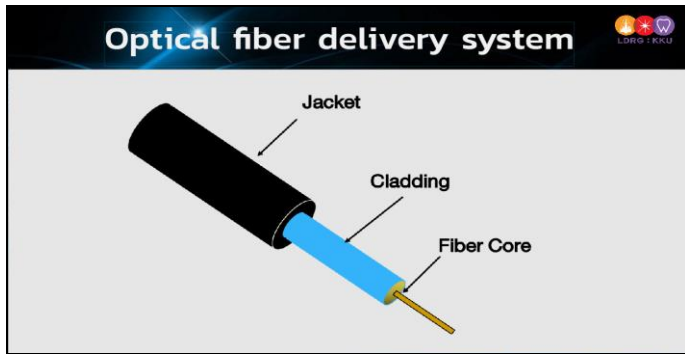
This type of laser sprays water from the handpiece, resembling a high-speed handpiece, to provide moisture to the target. This reduces heat from the photothermal reaction and protects the surrounding structures.



Slide 11 - Hollow Wave Guide Delivery System

Slide notes: Hollow wave guide: Uses a flexible hollow metal tube that is smaller and lighter than the articulating arm system. The internal surface of this tube reflects light without the use of mirrors. In order to reduce intensity, if the handpiece is moved farther from the focusing distance the light becomes less coherent. Since it is flexible, it can access narrow areas more easily than the articulating arm. However, the tube is prone to damage if it is flexed too much or mishandled





Slide 13 - Optical fiber delivery

Slide notes: The optical fiber delivery system

Uses materials that allow lasers to pass through at a molecular level such as crystalline and hydroxyl.

Silicone is wrapped around the cable to provide protection except at the tip, where the fiber core is exposed.

Laser is emitted at maximum intensity when the fiber core is in contact with tissue.

This type of system is convenient to use since it is lightweight, flexible and able to access narrow areas.

However, there are limitations to this system as the wavelength currently produced is only within the 100 to 1,000 nanometer range.

The fiber core tip also loses its light-emitting properties as it is continuously used which can be observed when the tip becomes more opaque and or pale. If the operator continues using the expired tip, combustion will occur causing carbon to form around the tip. Heat energy rather than light energy is then absorbed by the tissue from the hot tip, affecting a large area of the surrounding tissue and deforming it.

The optical fiber cable is therefore a consumable item that must be financially accounted.

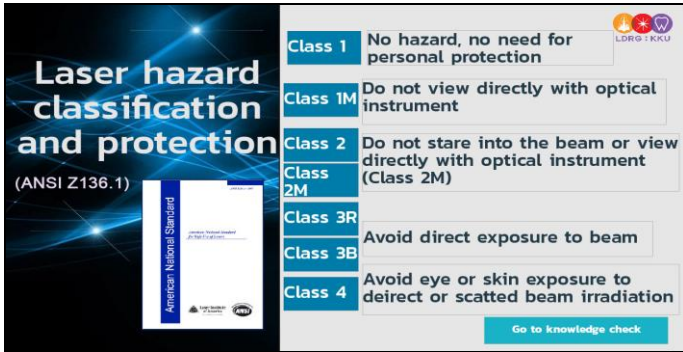


Slide 14 - diode laser and ndyag laser

Slide notes:

The examples of optical fiber delivery lasers are
diode lasers and Nd YAG laser

Slide 15 - Knowledge check for laser delivery



The slide is titled "Laser hazard classification and protection (ANSI Z136.1)". It features a blue background with a white box containing the text "American National Standard". To the right of the box is a table listing laser classes and their safety requirements. At the bottom right of the table is a button labeled "Go to knowledge check".

Class	Requirement
Class 1	No hazard, no need for personal protection
Class 1M	Do not view directly with optical instrument
Class 2	Do not stare into the beam or view directly with optical instrument (Class 2M)
Class 2M	
Class 3R	Avoid direct exposure to beam
Class 3B	
Class 4	Avoid eye or skin exposure to direct or scattered beam irradiation

Go to knowledge check

Slide 16 - Laser hazard classification

(ANSI: Z136.1)


Slide notes: Practically, the laser machines are classified by laser hazard in order to indicate the appropriate personal protection.

The examples of classification here based on American National Standard Institute(ANSI)

Please click on the button of classification to study more details or click to knowledge check for laser hazard classification.

Laser hazard classification and protection

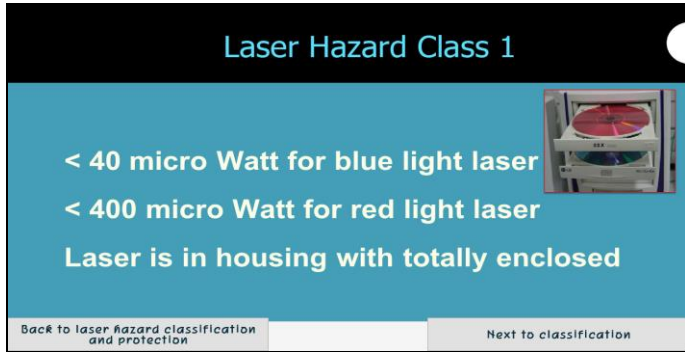
(ANSI Z136.1)



Class 1	No hazard, no need for personal protection
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Go to knowledge check

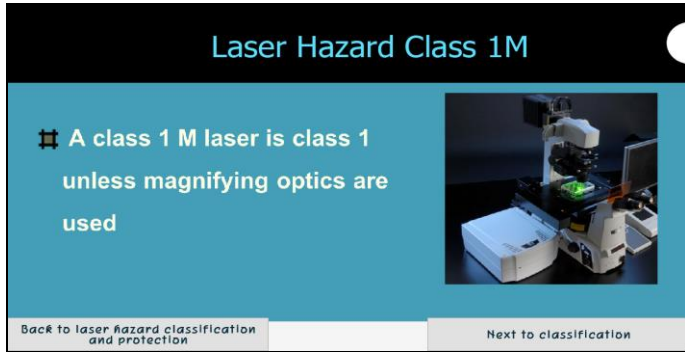
Slide 17 - Laser hazard classification



Slide 18 - Class 1 laser hazard

Slide notes: Class 1 laser hazard

The laser power is very low and be protected totally such a CD player. Therefore, this is no need for personal protection.



Slide 19 - Class 1M laser hazard



Slide notes: In case the laser beam, even very low power as identify into class 1, but the magnifying optics are used.

This needs eye protection and is classified in class 1M.

The example is a laser light microscope.

Laser Hazard Class 2

- ✦ Low-power visible light lasers (< 1mW)
- ✦ Does not cause eye damage
 - Viewing time 0.25 second (blinking reflex)



Back to laser hazard classification and protection Next to classification

Slide 20 - Class 2 laser hazard

Slide notes: Class 2 laser hazard

The laser wavelength is in the range of visible light; 400 to 700 nanometer, with the lower power outcome than 1 micro Watt.

The blinking reflex can protect the eyes.

Laser Hazard Class 2M

- A class 2M laser is class 2 unless magnifying optics are used
- Visible lasers incapable of causing injury in 0.25 s
- Eye protected by aversion response

Back to laser hazard classification and protection


Next to classification

Slide 21 - class 2M Laser Hazard

Slide notes: The Laser hazard class 2 M is the laser hazard class 2 which looking via magnifying optics including spectacles. The normal blinking reflex tends to protect the eyes.

Laser Hazard Class 3R

- Includes invisible and visible lasers
- Unsafty; High power laser more than group of class 2 but low power laser less than class 3B
- Aversion response may not provide adequate eye protection



Back to laser hazard classification and protection Next to classification


Slide 22 - Class 3R Laser Hazard

Slide notes: The laser hazard class 3 R is the lasers of which power are less than class 2 and more than class 3 B. The aversion response or blinking reflex may not enough to protect the eyes.

The example of this is the laser used in experimental laboratory.

Laser Hazard Class 3B

- From 0.5 W for UV-A to infrared lasers
- UV-B or UVC
- Direct and indirect viewing cause eye injury
- Eye protection is required in these areas



Back to laser hazard classification and protection

Next to classification

Slide 23 - Class 3B laser hazard

Slide notes: The laser hazard class 3 B is the lasers in the range from UV A to infrared regions at the power from 0.5 Watt and all types of UVB and UVC lasers.

The eye protection is needed.

Most of low intensity laser machines are in this classification.

Laser Hazard Class 4

- ⚠ >0.5 Watt lasers
- ⚠ Direct and indirect viewing hazard
- ⚠ Produce fire and skin hazards
- ⚠ Eye protection is required in these areas



[Back to laser hazard classification and protection](#)

Slide 24 - Class 4 laser hazard

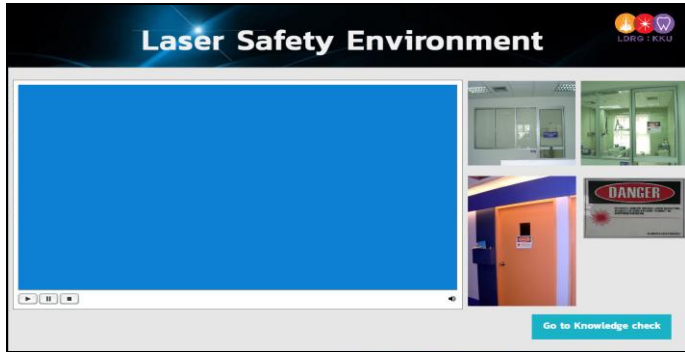
Slide notes: The laser hazard class 4 is all types of the lasers of which the power are more than 0.5 Watt.

Apart of eye protection, the soft tissue, not in the operative field is need to protect from laser ablative effect.

The laser plume must be evaporated by high power suction.

The therapeutic medical and dental lasers are in this classification.

Slide 25 - Laser hazard classification



Slide 26 - Laser safety environment

Slide notes: Please study the video showing you the key performances of laser safety enviromental setting.

After this you will answer the question for knowledge check and also the details of the video will be used for the part of answering the final evaluation.



Slide 27 - knowledge PPE

Slide notes: Please drag the correct personal protection equipment :PPE and drop to the answering boxes.






Slide 28 - The PPE for laser surgery in post-covid 19 era

Slide notes: The Lasers in Dentistry Research Group, KKU, now recommends the standard PPE with N 95 mask for laser surgery.

People operating or within the vicinity of the laser beam

- Lasers - delivery system
- Keys
- Safety Equipment (glasses, sign)
- Smoke evacuation systems
- Fire extinguishers: water storage
- Storage and handling of laser machines in places
- Intraoperative procedures

Back to study the other related factors for laser safety

Next to the final evaluation

Slide 29 - people

Slide notes: People operating or people within the area of the laser beam

must be followed the laser safety protocol for laser safety environment.

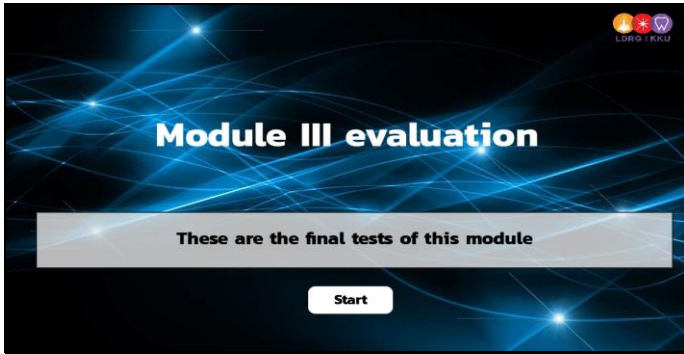
The checklists as you see in this slide are the guidelines that people operating laser must concern.

In practice, the laser safety officer is allocated

to be in charge for monitoring those checklists.

Please take you time to read all of the checklists after these

you will go to study the other laser safety factors or go to the final evaluation.



Slide 30 - The final part

Slide notes: Module III

Laser Safety

This module is concerning practical point for using lasers in dentistry with safety precaution and high efficacy.

You reach the final session of this module: laser safety.

Please click the start button to enter the knowledge evaluation.

Slide 31 - question 1

Question 4 of 4


Multiple Choice

2. From the video, please identify the incorrect laser safety practice ?

☒ A) Light protection of the room

☒ B) PPE of people within the room

☒ C) Plumbing suction



Review Area

You must answer the question before continuing.

◀ ◻ ▶

◻ ◻ ◻ ◻ ◻

▶

Submit

Slide 32 - question2

Quiz Results

You Scored:

{score}

Maximum Score:

{max-score}

Correct Questions:

{correct-questions}

Total Questions:

{total-questions}

Accuracy:

{percent}

Attempts:

{total-attempts}

Review Quiz

Exit

Review Area

Slide 33

Text Captions: Quiz Results