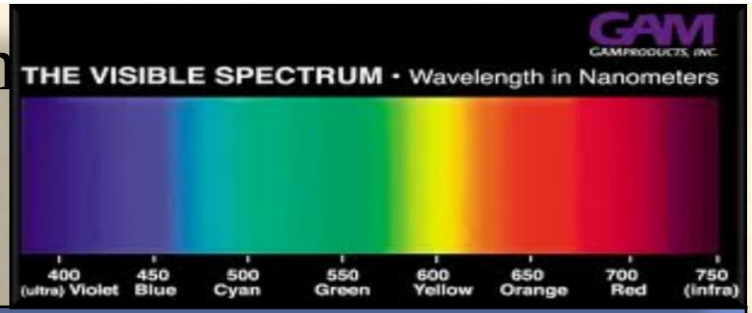
OCULAR HAZARDS FROM EXPOSED VISIBLE , IR , AND OTHER RADIATION

(A)VISIBLE LIGHT

- Sources & site of absorption



visible wavelength (nm)	Sources	Site of ocular damage
400-780	Sunlight; Incandescent , fluorescent and arc lamps	RPE , hemoglobin , macular pigment photoreceptors
	Lasers- argon , krypton	Resulting in visual loss , color vision problems

OCULAR EFFECT

- High levels of radiation within the visible spectrum can cause both photochemical & thermal injury
- The short wavelengths end of visible spectrum tends to produce photochemical damage
- The long wavelengths of visible spectrum tends to produce photochemical damage & thermal damage
- IR radiation produces only thermal damage

OCULAR EFFECT

- There are following degenerative changes to occur to rod & cones

a) Vacuole formation of the outer tip of the photoreceptor

b) The outer segment loses its lamellar structure & becomes tortuous & swollen

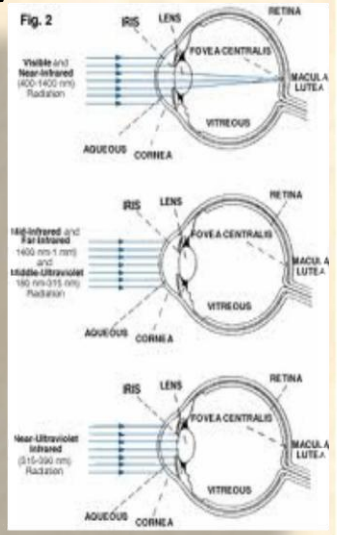
c) Outer segments breaks off from the inner segment

d) Photoreceptor disappear but remaining layers are intact

☙(I)VIOLET&BLUE RADIATION❧

- Violet & blue radiation have been implicated in the etiology of ARMD

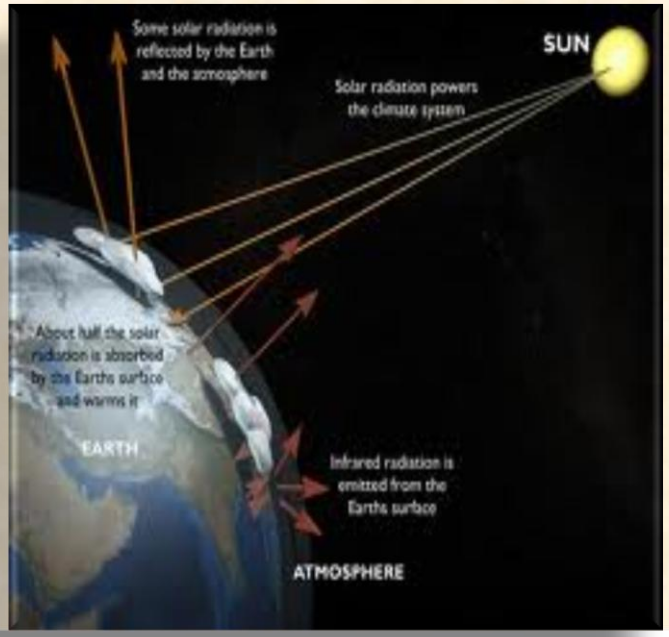
- Long-term exposure to low levels of UV & visible radiation damage to the photoreceptor-specially the cones & RPE



(II) SOLAR RETINOPATHY

- Caused by staring @ the sun , even for very short periods of time , with out suitable eye protection

- Damage primarily to photochemical trauma in the outer segment of photoreceptor



☙(B)INFRA-RED RADIATION ❧

- Sources & site of absorption

SPECTRAL DOMAIN		WAVELENGTH(nm)	SOURCES	SITE OF OCULAR DAMAGE
BIOLOGICAL	PHYSICAL			
IR-A	Near IR	780-1400	SUNLIGTH, ARC LAMP,ND-YAG LASER	PIGMENT EPITHELIUM OF RETINA,IRIS, CATARACT
IR-B	Far IR	1400-3000	SUNLIGHT,URBIUM LASER	CORNEAL & LENS EPITHELIUM
IR-C	Far IR	3000-10000	FURNACES, CO_2 LASER	CORNEAL EPITHELIUM, RESULTING CORNEAL OPACITY

OCULAR EFFECT

A. The cornea absorb IR-C RESULT → Opacification
B. The lens absorb IR-B RESULT → Cataract

ant.sub capsular opacity cortical cataract

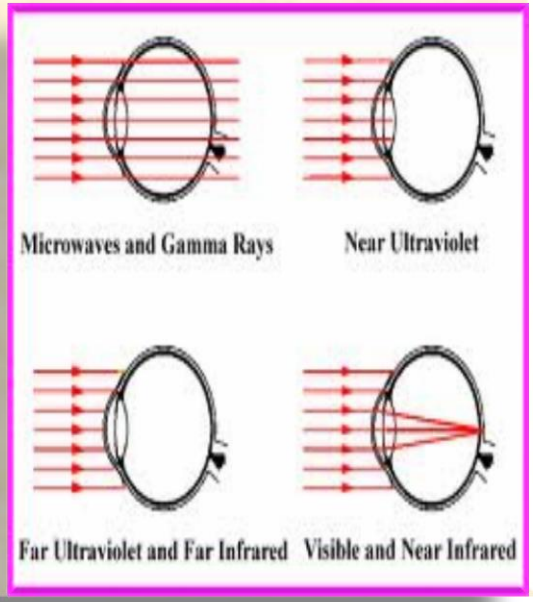
Infrared

Indirect Direct

OCULAR EFFECT

c. The Retina absorb IR-A RESULT retinal burns

IR-radiation absorb by the melanin pigment granules in pigmented epithelium & underlying choroid these result inflammatory response



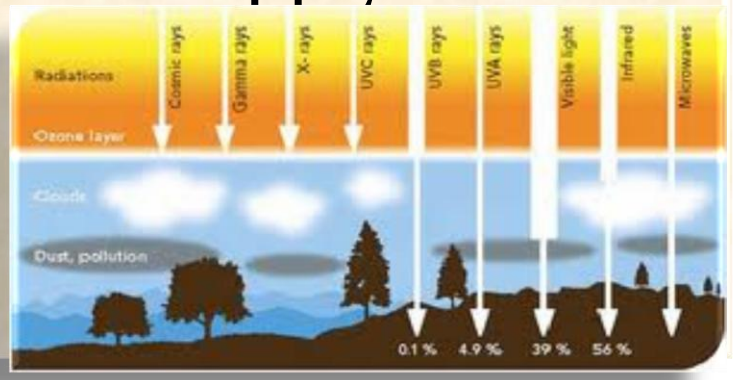
ಜ(c)OTHERS FORMS OF RADIATIONಜ

- X-rays and Gamma rays are known to produce adverse effects on the eye & living tissues
- Sources & site of absorption

Sources	Site of absorption	Ocular effects
X-ray	Lens epithelium and nucleus, resulting in cataract	Sensitivity of the ocular tissue decreasing, cataract,
Gamma ray	Lens epithelium and nucleus, resulting in cataract	Pigmentary changes in skin & dry eye

OCULAR EFFECT

- These radiation may have direct & indirect effect upon the tissues
- A direct action upon the cells can result in cells death
- Indirect damage can occur as a result of damage bl.vs , leading to a reduce blood supply of the tissue

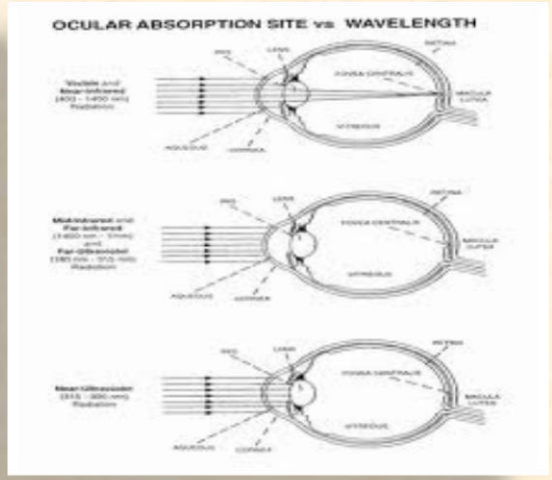


OCULAR EFFECT

- The most common effects are cataract formation because lens contain ocular tissue

- The latent period & the severity of lens damage depends on:

a) Duration & concentration , single or multiple exposure (>250nm can cause cataract)



b) Type of radiation-
low or high penetration

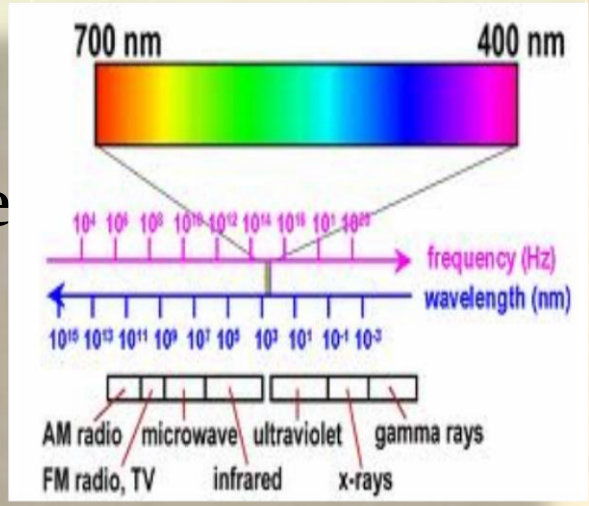
a) Age of the person-younger person
shorter latent period and greater the lens damage

☙ I.MICROWAVE RADIATION ❧

WAVELENGTH	SOURCES	SITE OF OCULAR DAMAGE
0.001m to 0.3 m	Microwave oven , FM radio, television & radar	Avascularity of intra ocular cavity will result increase temperature

- Absorption depends on :

a) Type of tissue: water base tissue absorb much more energy then fat or bone

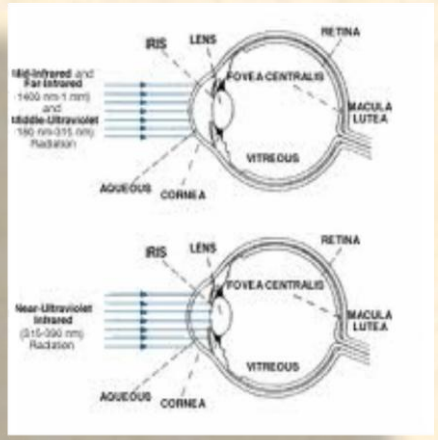


a) Tissue with higher amount of water absorb microwave energy , such as muscle tissue

☙ Absorption depends on...❧

- Wavelength:

a) Degree of penetration of microwave length is directly related to wavelength



b) Thermal effect of longer wavelength are more penetrate .

e.g: 1) 12cm microwave penetrate 1cm eye (up to post. Cortex of lens)

2) 3cm microwave penetrate 1mm eye (temperature raise up to cornea)

℘ Absorption depends on…℘

- Frequency :

a) relationship between microwave frequency & amount of absorption

b) Amount of absorption @ the surface expose tissue↑with↑ microwave frequency

OCULAR EFFECT

- Can only be assessed by experimental or clinical means
- Population surveys have failed to show a correlation between exposure & cataract formation

(B)LASER

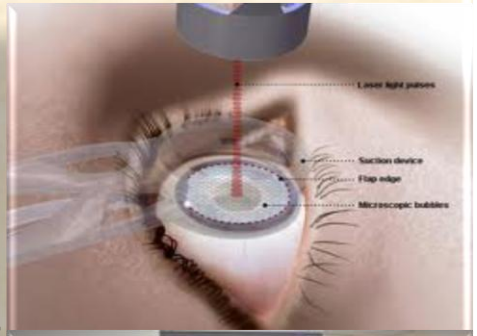
- Sources & site of absorption

SOURCES	WEAVE LENGTH	SITE OF ABSORTION	SITE OF OCUAR DAMAGE
Ruby , argon , YAG	For UV (300nm) to far IF (>1400nm) far	<300nm absorb cornea(damage corneal epithelium) 300-400 nm cataract	Depend on the weave length Absorb cornea crystalline lens

OCULAR EFFECT

- Cornea

UV laser emit radiation <300 nm absorb the will damage the corneal epithelium



- Lens

UV from 300-400 nm causes cataract

- Surgery

Wavelength of 193 nm was optimal for corneal surgery

OCULAR EFFECT

- Radiation from visible & IR laser focused on the retina can cause:

a) Thermal injury following absorb by melanin pigment epithelium and choroid

b) Photochemical damage , specially in the blue region of visible spectrum which absorb the inner retinal layer

OCULAR EFFECT

- Type & degree of retinal damage caused by a laser will depend upon :

a) Power density of the laser
b) Time of exposure
c) Size of image upon the retina
d) Wavelength & transmission through the ocular media
e) Degree of retinal and choroidal pigmentation

OCULAR EFFECT

- Ophthalmic instruments

Instruments	Avg.retinal irradiance	Safe time
Direct ophthalmoscope	29.0(mW)/cm2)	_
Indirect ophthalmoscope	7.8- 8.4 V	23
Slit lamp	6 V	13
Operating microscope emmetrope & myopes aphakic	100.0-970(mW)/cm2) 59-.0-590(mW)/cm2)	29-1.8 49-3.7

℘ Ophthalmoscope ☙

- Indirect ophthalmoscope can produce retinal irradiation 5 times greater then by a direct ophthalmoscope.
- Power of the condensing lens also effect the retinal irradiation

- IO is consider to be un safe

after 23 sec of exposure in a normal patient with clear media & dilated pupil.

SLIT LAMP

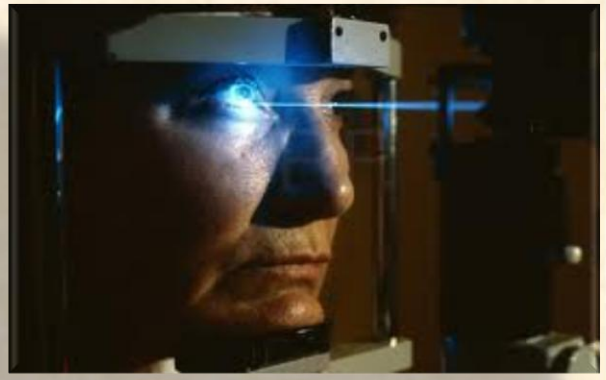
- Silt lamp examination of retinal procedure up to three time more irradiance then direct ophthalmoscope

- The level of irradiation depend on _

a) Lamp voltage

Range -140 mw/cm2 for 5 V lamp

-385 mw/cm2 for 7.5 V lamp



b) Safe duration for retinal examination short then IO as little as 10 sec for patient with retinal or macular degeneration

ꕥ OPERATIG MICROSCOPES ꕥ

- It can produce retinal irradiation 10 times greater then by a direct ophthalmoscope.
- Safe time varies from 1.8 to 49s which is relatively short during operation
- It has been suggested that corneal occluder be used during prolong procedure
- Light sources such as surgical illuminating lid speculum provide

℘ OPERATIG MICROSCOPES ☙

- Recommendations

a) Use IR filter to absorb wavelength longer then 700 nm

b) absorb wavelength below 450 nm eliminate blue light & UVA . This will improve light scattering & chromatic aberration

c) Use min amount of light &

time necessary for examination

REFERENCE

- " Work & the eye " rachel v, north , 2nd edition
- " clinical optic " troy E. Fannin , theodore Grosvenor , 2nd edition

Thank you