

Physiology of the



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Study Objectives

- Understand the mechanism of pain stimulation.
- Discuss the referred pain .
- Describe the pain analgesia system.

Pain Sensation

- Definition: It is a **prepotent protective** unpleasant sensation resulting from **tissue damage**.
- Pain Receptors: Nociceptors (free nerve ending)
- Types of Pain Receptors:
 - 1-Mechanical pain receptors.
 - 2-Thermal pain receptors.
 - 3-Chemical pain receptors.



Distribution of pain receptors

Widely distributed

- Skin
- Periosteum
- Arterial walls
- Joint surface
- tentorium of cranial cavity

Less distributed

Deep tissues
& Viscera

Absent

- Liver
- Lung alveoli
- Brain tissue
- Bone

Mechanism of Stimulation of Pain Receptors:

prepotent protective

Can't Miss That".

Chemical

Mechanical

Thermal

Tissue damage

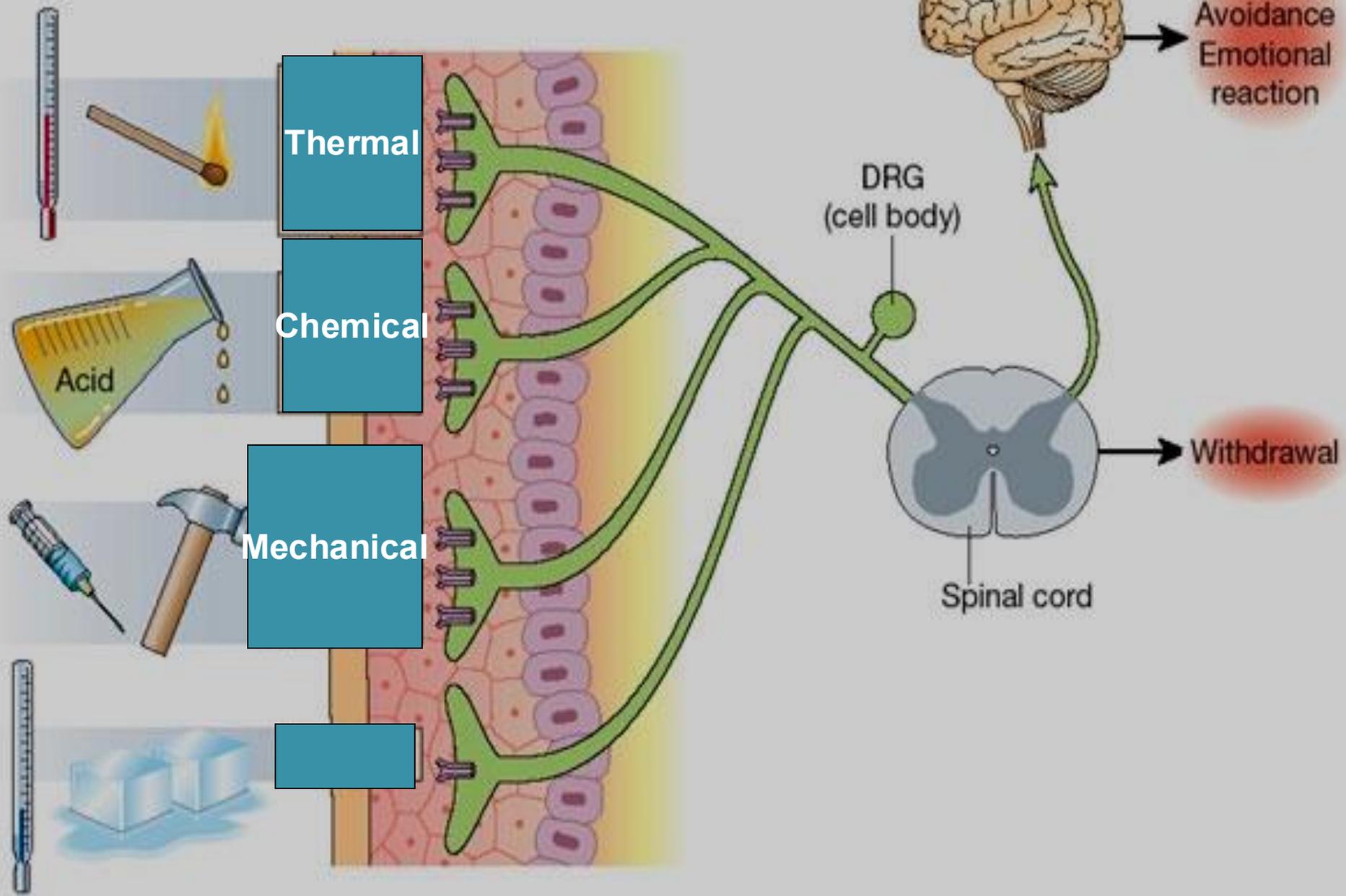
Histamine, serotonin, bradykinin, substance P
prostaglandin, acids and excess K

Pain producing substances

Pain Receptors

اکثر ماده تسبب الم
bradykinin

a Nociceptive pain



Thermal

Chemical

Mechanical

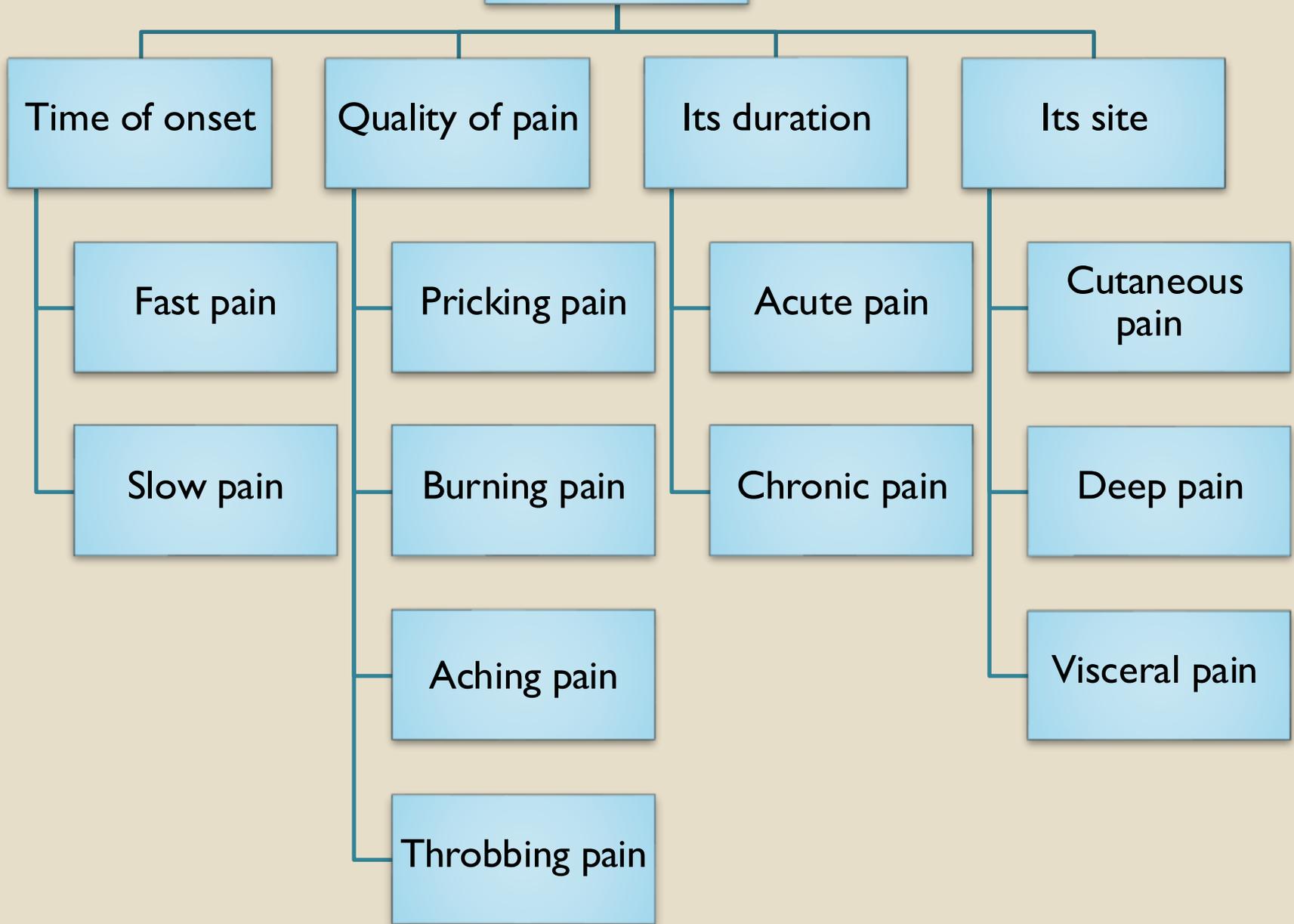
DRG
(cell body)

Spinal cord

Pain
Avoidance
Emotional
reaction

Withdrawal

Types of pain



● Types of Pain:

1- According to the time of onset:

	Fast or first (immediate) pain	Slow or second (delayed) pain
Site:	Cutaneous only.	Cutaneous, deep or visceral.
Quality:	Pricking (sharp).	Burning (aching)
Perception:	Within 0.1 sec. after stimulus. (i.e. during injury)	One second or more after stimulus (i.e. after injury).
Duration:	Very short duration (less than one second).	Longer duration (seconds to few minutes).
Localization:	Well-localized.	Diffuse (poorly localized).
Conducting nerve:	A-delta fibers (12-30 m/sec).	C fibers (0.5-2 m/sec).
Depression:	By pressure	By local anesthesia and analgesics
Neurotransmitter	Glutamate	Substance-P (slow-substance P)
Importance:	Initiates the protective withdrawal reflex	It can arouse one from sleep and urges the person to take required treatment to prevent major damage.

Pain Sensation

2) According to site of origin: 3 types;

Cutaneous pain

- From **skin** and **subcutaneous** tissues
- Usually **pricking** or **burning** pain

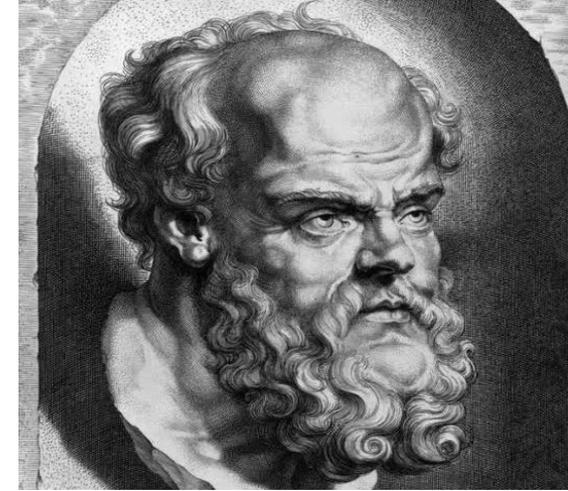
Deep pain

- From **structures deep to the skin** e.g. skeletal ms, joints, and tendons
- Usually **dull aching** or **throbbing**

Visceral pain

- From **internal viscera** e.g. stomach
- Usually **colicky** or **dull aching**

SOCRATES



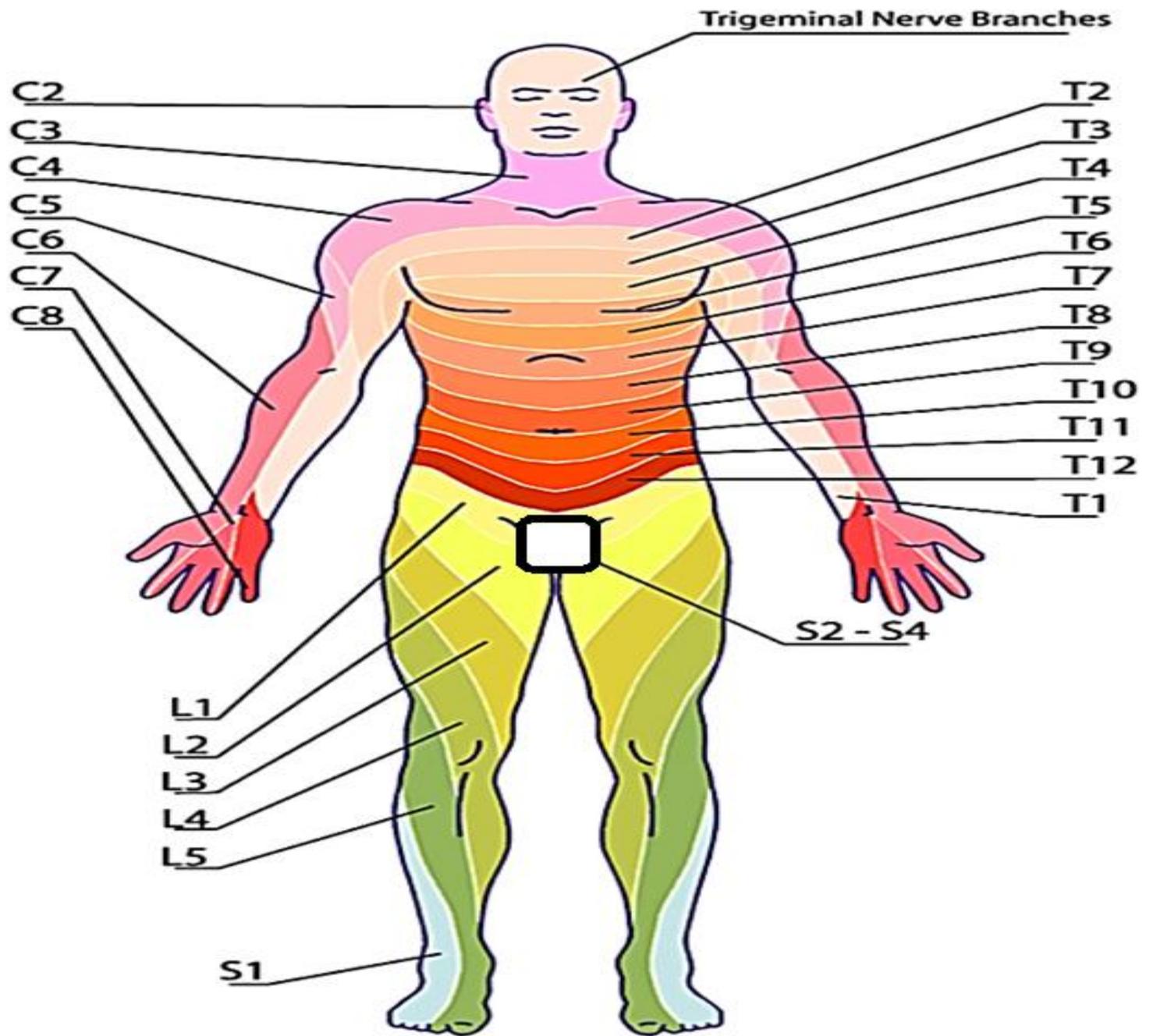
- **S**ite: (Localized vs. Diffuse)
- **O**nset: (sudden or gradual)
- **C**haracter: (Sharp, dull, throbbing, burning, electric) **R**adiation:
- **A**ssociated symptoms: "Any swelling, fever, bad taste, numbness?"
- **T**iming: "Is it constant or intermittent? Worse at night?"
- **E**xacerbating/Relieving factors: Chewing, hot, cold, sweet?

Referred Pain

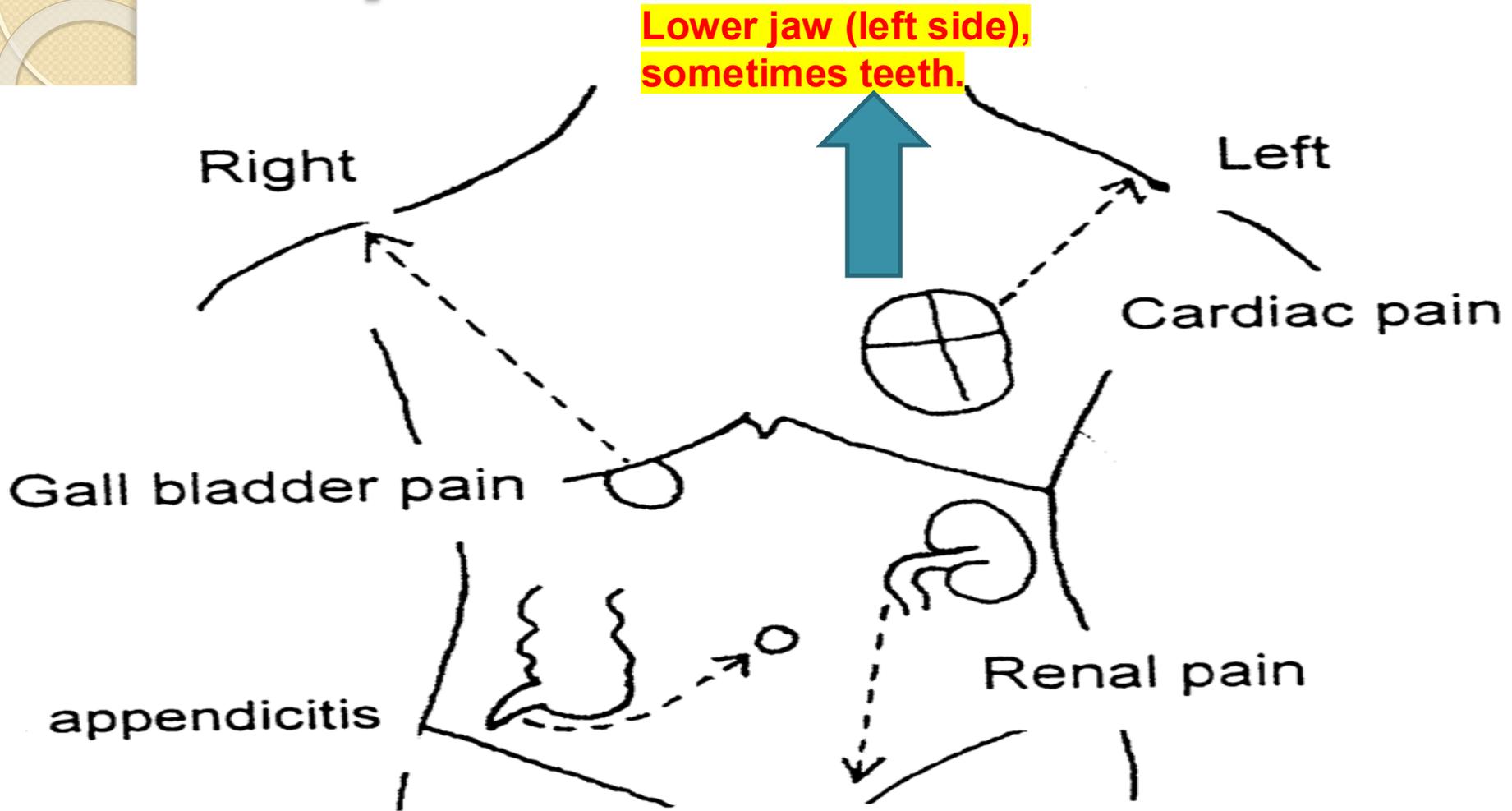
- Definition: This is pain that felt away from its original site.

- Why This Site Specially (=Dermatomal Rule):

which are supplied by the same **embryonic** dorsal roots that supply the diseased viscus. There is a **distance** between site of origin of pain and site of referred pain due to migration of organs during development to their normal location.



● Examples of Referred Pain:



Dentists must consider non-odontogenic causes when patients report unexplained facial or jaw pain—especially if linked to systemic disease (e.g., angina).



Referred Pain in



**Cardiac Pain
Referred to Jaw**
ORIGIN:
Myocardial ischemia
REFERRED AREA
Jaw



Maxillary Sinusitis
ORIGIN:
Inflammation
REFERRED AREA
Teeth



**Cervical Spine
Disorders**
ORIGIN:
Nerve compression
REFERRED AREA
Mandible, teeth, or facial pain



Ear Infections
ORIGIN:
Middle ear pathology
REFERRED AREA
Mandible



Referred Pain in Dentistry

-Maxillary Sinusitis

- **Referred Area:** Upper molar teeth (often mimics toothache).
- **Clinical Clue:** Tooth is intact; pain worsens when bending down; tenderness over sinus.

Cardiac Pain Referred to Jaw

- **Referred Area:** Lower jaw (especially left side), sometimes teeth.
- **Clinical Clue:** No dental pathology; pain increases with exertion or emotional stress.



Referred Pain in Dentistry

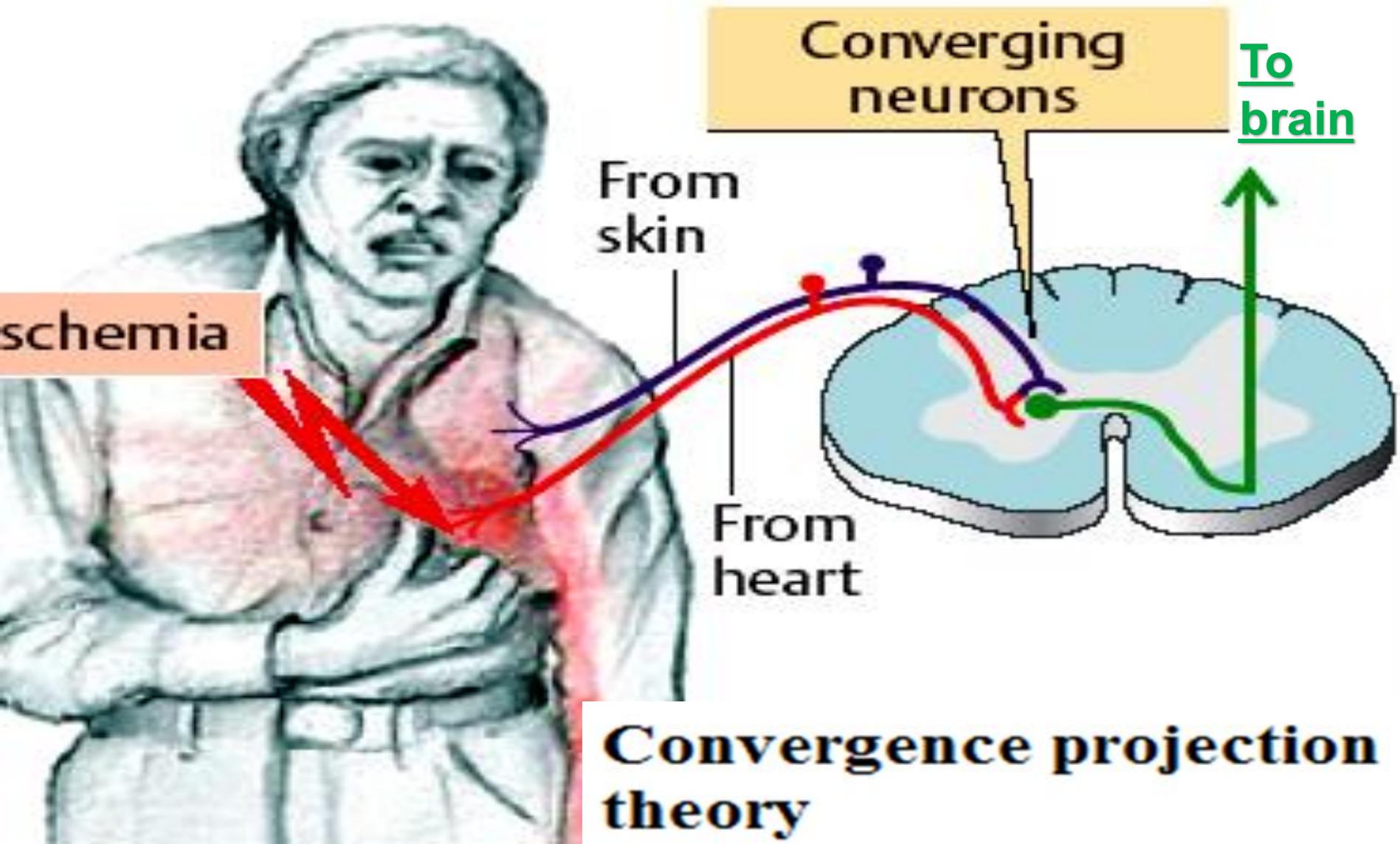
-Ear Infections or Otitis Media

- **Origin:** Middle ear pathology.
- **Referred Area:** Posterior molars or mandible.
- **Clinical Clue:** Ear symptoms with no dental cause.
- **Why?** Shared nerve supply via **cranial nerves V and IX.**

-Cervical Spine Disorders

- **Origin:** Nerve compression in the neck (C2-C3 roots).
- **Referred Area:** Mandible, teeth, or facial pain.
- **Clinical Clue:** Neck stiffness, headaches; pain not linked to any tooth.

Referred pain mechanism



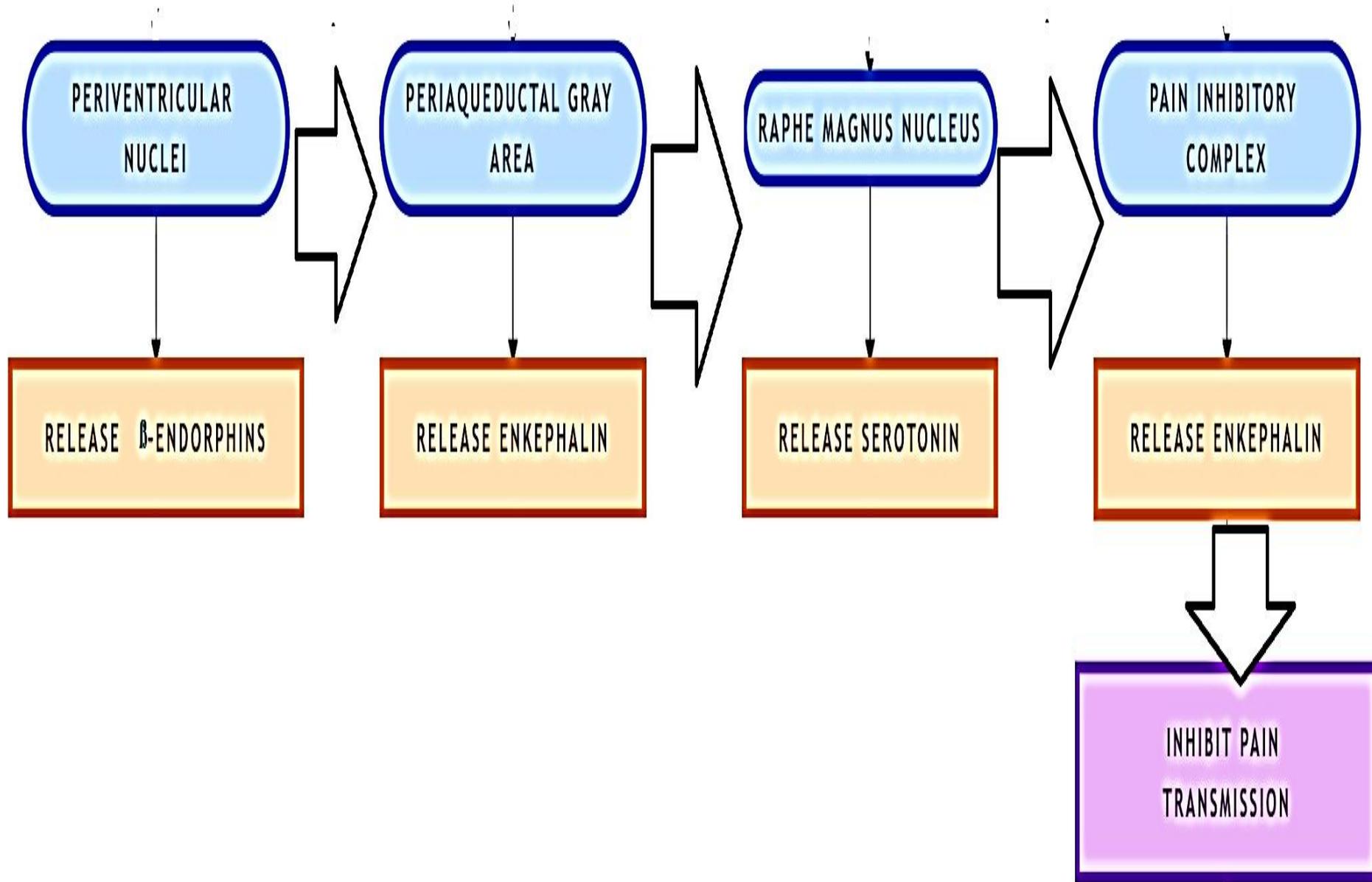
Pain Analgesia System

● Parts:

- 1-The periventricular nuclei & medial forebrain bundle in the hypothalamus.
- 2-The periaqueductal gray (PAG) area in the mid brain & upper pons.
- 3-The raphe magnus nucleus in the lower pons & medulla.
- 4-A pain inhibitory complex in the dorsal horns of the spinal cord

PAG = Pain Away Goodbye" (analgesia).

Pain Analgesia System



● Stress Analgesia

- During stressful conditions (fight or flight)
⇒ the cerebral cortex & the hypothalamus activate the analgesia system, which blocks the conduction of pain signals at the two gates of pain.
- In this way, pain may not to be felt during stress, e.g. a soldier during heat of a battle may not feel the pain of a major injury until the battle is over.

Acupuncture



Cutaneous Hyperalgesia

● **Definition:** It is a pathological condition of the skin in which pain is produced by non nocuous stimuli, or in which nocuous stimuli produce more pain than they normally do.

● **Causes:** a-Injury of the skin as burning & exposure to ultraviolet rays.

B-Inflammation of the skin.

C-Irritation of dorsal roots.

D- It may be a manifestation of deep or visceral diseases.



healthy skin

area of flare

area of injury

Primary hyperalgesia

Secondary hyperalgesia

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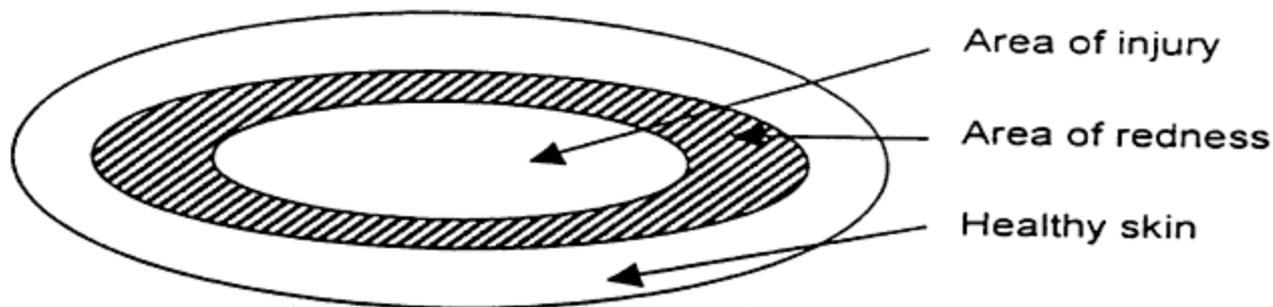
● Types and Mechanisms:

I-Primary hyperalgesia: -Site: It is in the injured area & red area caused by spreading flare. It develops 30 to 60 minutes following skin injury and lasts for several hours or days.

-Threshold of pain is lowered.

- Mechanism: (the local axon reflex):

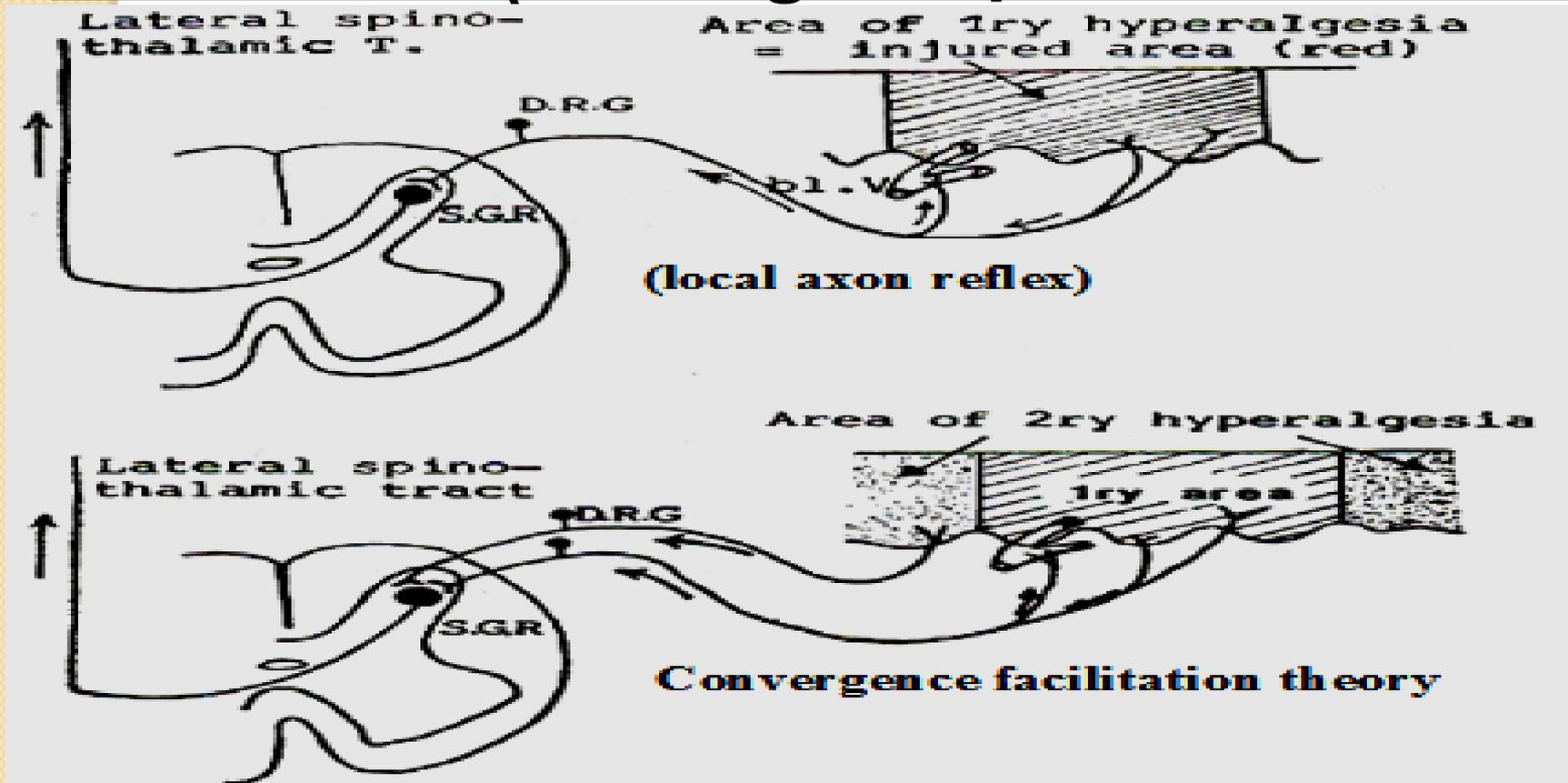
- *Allodynia is a severe 1^{ry} hyperalgesia in which a gentle stimulus like touch of cloths produce sever pain.*

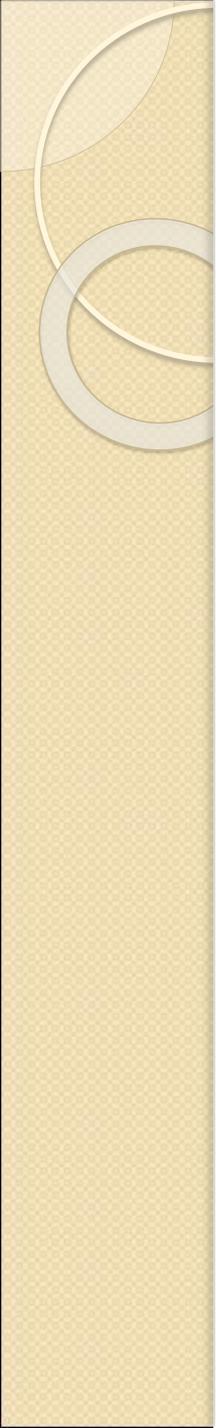


2-Secondary hyperalgesia:

-Site: This occurs in the healthy skin around the injured area. -The pain threshold is not lowered but it is normal or even elevated.

- Mechanism: (*Convergence facilitation theory*)





THANK YOU