

	Nociceptive Pain	Neuropathic Pain
<b>Duration</b>	• Resolves when damaged tissue heals, but can be chronic	• Almost always a chronic condition
<b>Intensity</b>	• ↓ with duration	• ↑ with duration
<b>Allodynia</b>	• Absent	• Present
<b>Character</b>	• Proximal radiation > Distal radiation	• Distal radiation common
<b>Hypersensitivity</b>	• Uncommon	• Present (allodynia/hyperalgesia)
<b>Treatment</b>	• First-line: NSAIDs, Acetaminophen • Severe pain: Opioids	• Anticonvulsants, Antidepressants, Opioids • TENS, sympathetic blocks

Which of the following belongs to Neuropathic pain versus Nociceptive pain?

- A. Resolves when damaged tissue heals
- B. Intensity decrease with duration
- C. Proximal radiation is more common than distal radiation
- D. Presence of allodynia and hyperalgesia

	Nociceptive Pain	Neuropathic Pain
<b>Treatment</b>	• First-line: NSAID, Acetaminophen • Severe pain: Opioids	• Anticonvulsants, Antidepressants, Opioids • TENS, sympathetic blocks

#### PATHOGENESIS

- Multiple theories postulated.
  - Abnormal adrenergic sensitivity develops in injured nociceptors, and circulating or locally secreted sympathetic neurotransmitters trigger the painful afferent activity.
  - Cutaneous injury activates nociceptor fibers → central pain-signaling system → pain.
  - Central sensitization of pain signaling system
  - Low-threshold mechanoreceptor input develops capacity to evoke pain.
  - With time, efferent sympathetic fibers develop capacity to activate nociceptor fibers.



- **Intense pain**  
(nociceptive + neuropathic)
- **Swelling**
- **Skin, hair, nail changes**

A 24-year-old man presents to you with right forearm pain. He states that the pain began 6 months ago, after an elevator door closed on his right forearm. On exam, the right forearm has shiny skin, with decreased hair growth, and the area is very tender to touch. You make a presumptive diagnosis of:

- A. Cellulitis
- B. Scleroderma
- C. Complex regional pain syndrome
- D. Synovitis

#### Complex regional pain syndrome (CRPS)

- Pain syndrome, usually preceded by an inciting event, either trauma or a period of immobilization.
- It is associated with a hyperactive sympathetic nervous system.
- It is characterized by **intense pain** and sensitivity to light touch, with both nociceptive and neuropathic features.
- **Swelling** and **excessive or lack of hair growth** when compared with the other extremity is usually noted.

#### IASP Diagnostic Criteria for CRPS

1. Presence of an initiating noxious event or a cause of immobilization.
2. Continuing pain, allodynia, or hyperalgesia in which the pain is disproportionate to any known inciting event.
3. Evidence at some time of edema, changes in skin blood flow, or abnormal sudomotor activity in the region of pain (can be sign or symptom).
4. This diagnosis is excluded by the existence of other conditions that would otherwise account for the degree of pain and dysfunction.

- **Two main types:**
  - **CRPS I** (formerly RSD) is diagnosed if the previous symptoms occur from soft tissue injury without confirmed nerve injury in the affected limb.
  - **CRPS II** is diagnosed if the symptoms occur after direct nerve damage. Also known as **causalgia**.

CRPS type I (Reflex Sympathetic Dystrophy)	CRPS type II (Causalgia)
<ul style="list-style-type: none"> <li>• Generally develops after minor trauma or surgery and does not involve a clinically identifiable peripheral nerve injury.</li> </ul>	<ul style="list-style-type: none"> <li>• A sympathetic-mediated pain limited to a peripheral nerve distribution.</li> </ul>

**Complex regional pain syndrome (CRPS) type I is:**

- A. Also known as **reflex sympathetic dystrophy**
- B. Sympathetic-mediated pain limited to a peripheral nerve distribution
- C. Reported in 25% of tetraplegic stroke patients
- D. Also known as **causalgia**

CRPS type I (RSD)	CRPS type II (Causalgia)
NOT involved a clinically identifiable peripheral nerve injury	associated with peripheral nerve injury

<b>CRPS type I</b>	<ul style="list-style-type: none"> <li>• Also known as <b>Reflex Sympathetic Dystrophy</b></li> <li>• Generally develops after minor trauma or surgery and does not involve a clinically identifiable peripheral nerve injury.</li> <li>• The most common subtype of RSD in stroke patients (reported in about 12%–25% of hemiplegic stroke patients).</li> </ul>
<b>CRPS type II</b>	<ul style="list-style-type: none"> <li>• Previously known as <b>Causalgia</b>, is associated with damage to a peripheral nerve.</li> <li>• The sympathetic nervous system is also thought to play a role in the pathophysiology of CRPS, however it is not clearly understood. Sympathetic and catecholaminergic dysfunction may be responsible for autonomic manifestations in CRPS.</li> </ul>

**Which of the following is associated with peripheral nerve damage?**

- A. Complex regional pain syndrome Type I
- B. Complex regional pain syndrome Type II
- C. Myofascial Pain Syndrome
- D. Phantom Limb Pain

- In myofascial pain syndrome, sensitive areas in tight muscles, or trigger points, can cause strain and pain throughout the muscle and referred area.
- The exact cause of phantom pain is unclear, but it appears to originate in the spinal cord and brain.

Stages	Symptoms	Time Frame
<b>Acute stage</b>	<ul style="list-style-type: none"> <li>▶ Affected limb swollen, red, burning</li> <li>▶ Increased diaphoresis of affected limb</li> <li>▶ All symptoms are near the site of original injury</li> </ul>	Within weeks of injury
<b>Dystrophic stage</b>	<ul style="list-style-type: none"> <li>▶ Skin of limb is cool and diaphoretic</li> <li>▶ Sudek's atrophy of bone on X-ray</li> <li>▶ Pain occurs throughout limb, not just at site of injury</li> </ul>	Within months of injury
<b>Atrophic stage</b>	<ul style="list-style-type: none"> <li>▶ Skin becomes pale and shiny</li> <li>▶ Atrophy of muscle and bone in the affected limb</li> <li>▶ Pain may be constant even with treatment</li> </ul>	For years after injury

<b>Stage 1 (acute)</b>	characterized by burning pain, dependent edema, redness, hyperhidrosis, coolness to touch
<b>Stage 2 (subacute)</b>	characterized by severe pain, fixed edema, and cyanosis or pallor
<b>Stage 3 (chronic)</b>	pain may have subsided, edema subsided, and the extremity is generally stiff

Which stage of complex regional pain syndrome (CRPS I) is characterized by burning pain, dependent edema, and redness?

- A. Stage I
- B. Stage II
- C. Stage III
- D. Stage IV

The three clinical stages of Type 1 CRPS are acute, subacute, and chronic.	
<b>ACUTE</b>	<ul style="list-style-type: none"> <li>The <b>acute</b> form lasts approximately 3 months.</li> <li>Pain, often burning in nature, is one of the first symptoms that initially limits function. Swelling, redness with vasomotor instability that worsens with dependency, hyperhidrosis, and coolness to the touch are common physical findings. Demineralization of the underlying bony skeleton begins because of disuse.</li> </ul>
<b>SUBACUTE</b>	<ul style="list-style-type: none"> <li>If the process is not arrested or reversed in the acute phase, the condition may progress to the <b>subacute</b> stage, which can last for up to 9 months.</li> <li>The patient develops persistent severe pain in the extremity and fixed edema that would have been reversible with elevation during the acute phase. The redness of the acute stage gives way to cyanosis or pallor and hyperhidrosis to dry skin. Loss of function progresses, both because of increased pain and fibrosis of the joints caused by chronic inflammation. In the hand, this leads to flexion deformity of the fingers. The skin and subcutaneous tissues begin to atrophy. Demineralization of the underlying bony skeleton becomes pronounced.</li> </ul>
<b>CHRONIC</b>	<ul style="list-style-type: none"> <li>If the process continues, the <b>chronic</b> phase may develop approximately 1 year after disease onset.</li> <li>This stage may last for many years or can be permanent. Pain is more variable during this period. It may continue undiminished or abate. Edema tends to subside over time, leaving fibrosis around the involved joints. The skin is dry, pale, cool, and shiny. Flexion and extension creases are absent. Loss of function and stiffness are marked, and osteoporosis is extreme. In the upper extremity, this can manifest as a frozen shoulder and claw hand.</li> </ul>

#### STAGES (OF CRPS)

- Stage 1 (acute):** Burning pain, diffuse swelling/edema, exquisite tenderness, hyperpathia and/or allodynia, vasomotor changes in hand/fingers (increased nail and hair growth, hyperthermia or hypothermia, sweating). Lasts 3 to 6 months.
- Stage 2 (dystrophic):** Pain becomes more intense and spreads proximally, skin/muscle atrophy, brawny edema, cold insensitivity, brittle nails/nail atrophy, decreased ROM, mottled skin, early atrophy, and osteopenia (late). Lasts 3 to 6 months.
- Stage 3 (atrophic):** Pain decreases; trophic changes occur; hand/skin appear pale and cyanotic with a smooth, shiny appearance, feeling cool and dry; bone demineralization progresses with muscular weakness/atrophy, contractures/flexion deformities of shoulder/hand, tapering digits; no vasomotor changes.

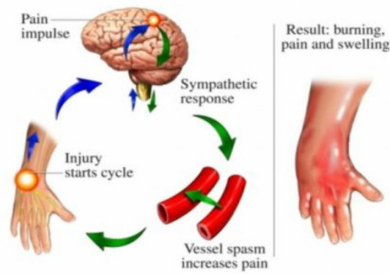
Which stage of Complex Regional Pain Syndrome may be the least painful but the most dysfunctional?

- A. Stage I
- B. Stage II
- C. Stage III

#### Clinical features of CRPS

<b>Stage I (Acute)</b>	<b>pain</b> and sensory abnormalities (hyperalgesia and allodynia), vasomotor and sudomotor dysfunction, and edema.
<b>Stage II (Dystrophic)</b>	<b>worsened pain</b> and sensory dysfunction, persistent vasomotor dysfunction, and significant motor and trophic changes.
<b>Stage III (Atrophic)</b>	progressive vasomotor, motor, and trophic changes, but <b>decreased pain</b> and sensory dysfunction.

## Complex Regional Pain Syndrome



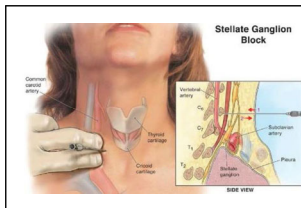
### • Two types of treatment

#### 1. Conservative treatment

- Most important: early active mobilization physical therapy combined with pharmacotherapy, psychological therapy

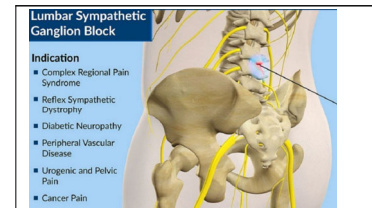
#### 2. Interventional management

- Sympathetic block
- Spinal cord stimulator



#### Stellate ganglion block:

Alleviation of pain following sympathetic blockade of the stellate ganglion using local anesthetic is the gold standard for diagnosis of sympathetically mediated CRPS type I.



#### Indication

- Complex Regional Pain Syndrome
- Reflex Sympathetic Dystrophy
- Diabetic Neuropathy
- Peripheral Vascular Disease
- Urogenic and Pelvic Pain
- Cancer Pain

- **Treatment for CRPS can be difficult and frustrating.** Each patient will be different, and an individualized approach is essential. Aggressive early treatment should be emphasized through an interdisciplinary approach. Most treatments are not well-documented in the evidence-based literature. Early physical and occupational therapy is important.
- **Sympathetic block** is the most appropriate first choice for treatment as CRPS may be **sympathetically mediated pain** (this condition occurs when the sympathetic nervous system inexplicably sends pain signals to the brain).
- **Medication management** to include corticosteroids and bisphosphonates are best supported in the literature. Other adjuvant medication can be considered, as previously described. Different pharmaceutical interventions can then be attempted to try to improve symptoms.

Which of the following is the most appropriate initial interventional treatment for Complex Regional Pain Syndrome (CRPS)?

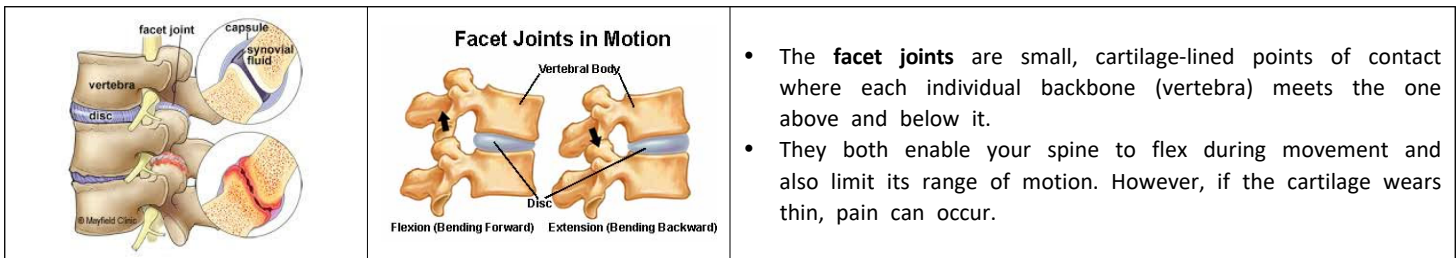
- Epidural steroid injection
- Sympathetic block
- Spinal cord stimulator trial
- Radiofrequency sympathectomy

- **Sympathetic blockade** can be considered as the first interventional technique.
- As there are not any signs of inflammation, epidural steroid injection would not be indicated. Spinal cord stimulator trials and radiofrequency procedures are not first line treatments.

### • Treatments:

- Functional restoration in a multidisciplinary setting is a hallmark of successful management.
- Medications: NSAIDs, antidepressants, anticonvulsants, opioids (limited data), topical dimethyl sulfoxide (DMSO), and oral N-acetylcysteine (NAC)
- Therapeutic sympathetic nerve blocks may be useful if diagnostic sympathetic blocks are positive. Case reports support use of intrathecal baclofen and spinal cord stimulation (SCS). IV lidocaine infusion is used in refractory cases.



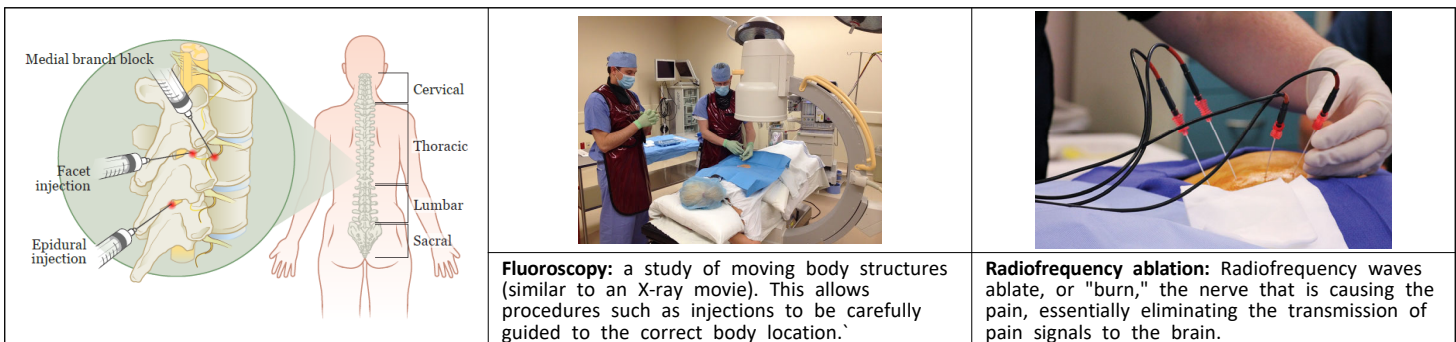


Which of the following statements is not true regarding facet joint-mediated pain?

- A. Rehabilitation should be focused on exercises with neutral or flexion posture to reduce stress on facet joints
- B. Diagnostic use of facet joint nerve blocks and therapeutic radiofrequency ablation are treatment options
- C. To minimize the false-positive response that occurs with one injection, two separate blocks using different-duration anesthetics are recommended
- D. Facet joint-mediated pain is likely elicited on flexion or repetitive end-range flexion

#### Facet joint-mediated pain

- Rehabilitation exercises are performed primarily with the spine in a **neutral** posture or in **flexion** to reduce stress on facet joints.
- Spine stabilization, core stabilization exercises, posture correction, and a strengthening program to restore functional movements should be initiated.
- Often elicited on **extension** or with rotation-extension combined movements.
- Point tenderness may occur in the paravertebral regions.
- Diagnostic facet joint nerve blocks and therapeutic radiofrequency ablation are also treatment options, if indicated.



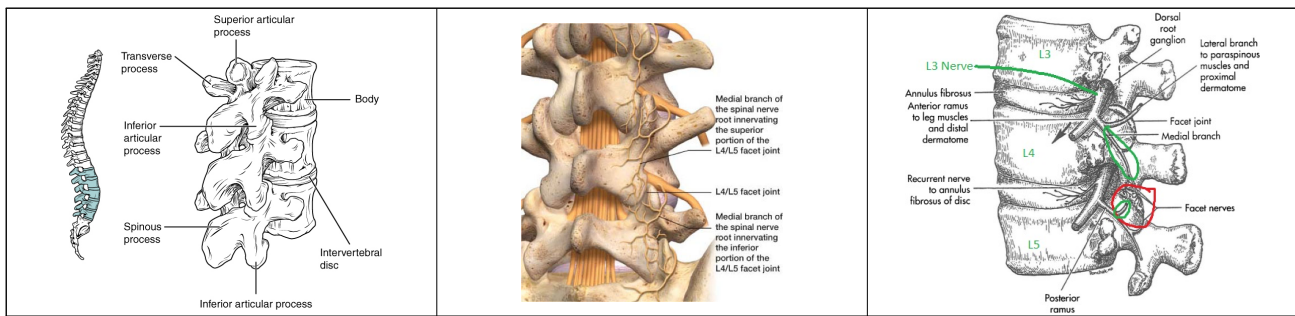
Which intervention may be used for diagnosis of facet joint-mediated pain?

- A. Fluoroscopically-guided facet joint injection
- B. Interlaminar epidural injection
- C. Transforaminal epidural injection
- D. Caudal epidural injection

#### Facet joint-mediated pain

- Diagnosis:** Both fluoroscopically-guided facet joint injection and fluoroscopically-guided medial branch block may be used
- Treatment:** Fluoroscopically-guided medial branch ablation is usually performed

<b>Epidural Steroid Injections</b>	<ul style="list-style-type: none"> <li>Epidural Steroid Injections are used for <u>therapeutic</u> reasons in the treatment of radiculopathy (pain that radiates from the lower back all the way down to either lower extremity) that can be caused by conditions such as spinal stenosis, disc herniation, annular tear, compression fracture, or degenerative changes.</li> <li>Epidural injections involve injecting an anesthetic as well as an anti-inflammatory medication such as a steroid (cortisone), near the affected nerve to help reduce the inflammation and help alleviate pain.</li> </ul>
<b>Facet Joint Injections</b>	<ul style="list-style-type: none"> <li>Facet Joint Injections are used for both <u>diagnostic</u> and <u>therapeutic</u> reasons in the treatment of degenerative or arthritic conditions in the facet joints that allows twisting, turning, and bending that does not radiate all the way down to the lower extremities.</li> <li>Facet joint injections usually have two goals: ① to help diagnose the precise cause along with the location of pain, ② to help provide alleviation of pain. If the facet injections indicate that the nerve is the source of cervical, thoracic, or lumbar spine pain, the next step would be to consider <b>radiofrequency ablation</b>.</li> </ul>

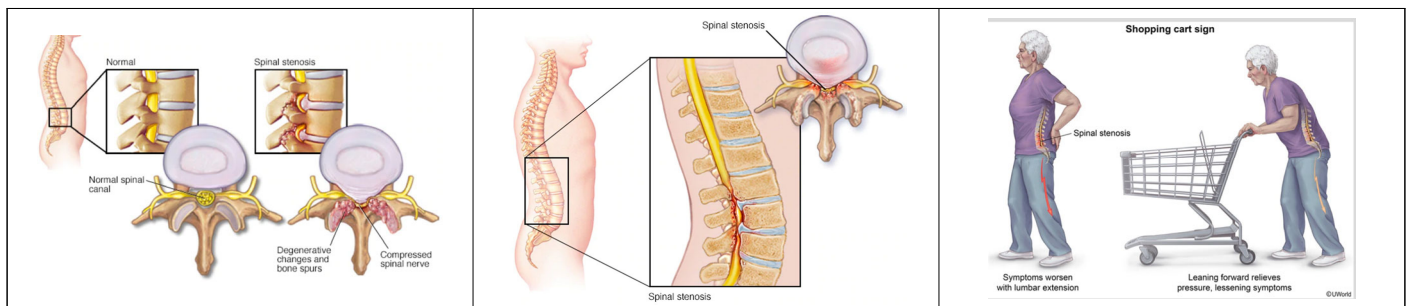


Which nerve innervates the L4/L5 facet joint?

- A. L2 and L3 medial branches  
 B. L3 and L4 medial branches  
 C. L4 and L5 medial branches  
 D. L4 dorsal ramus

- Each lumbar and thoracic facet joint (except L5/S1 facet joint) is innervated by the medial branches of dorsal rami exiting at the same level and one level above.
- The L4/L5 facet-joint is innervated by the **L3 and L4 medial branches**.

L3 medial branch	L4 median branch
inferior articular process	superior articular process

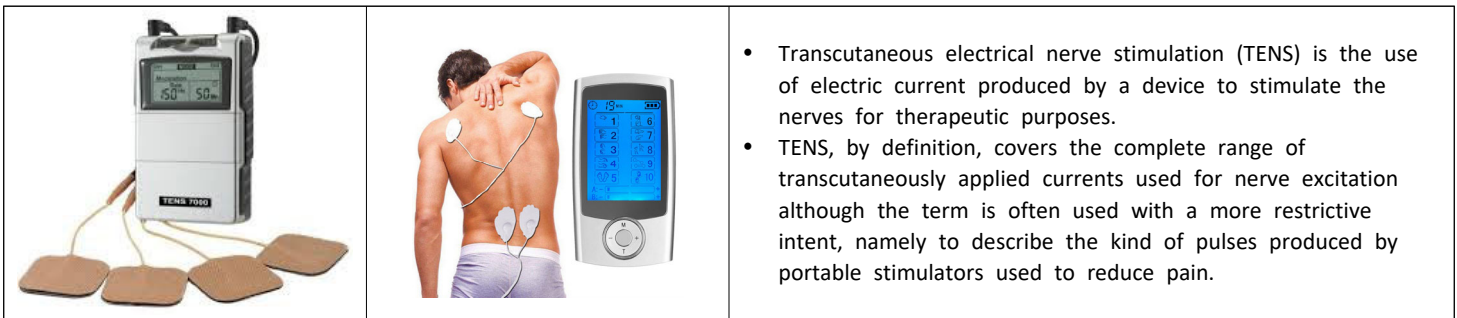


A 70-year-old man presents to your office with axial back pain that is worse with standing and walking. At times he also experiences pain radiating from the lumbar spine into the legs when walking. What is the most likely diagnosis?

- A. Lumbar spinal stenosis  
 B. Sacroiliac joint pain  
 C. Ischial bursitis  
 D. Piriformis syndrome

- The case presentation is a classic example of a patient suffering with lumbar spinal stenosis and **neurogenic claudication**.
- Spinal stenosis**: narrowing of the spaces within the spine, which can put pressure on the nerves that travel through the spine.
- Sacroiliac joint pain and ischial bursitis typically presents with pain upon sitting. Piriformis syndrome presents with buttock pain and sciatica, not axial pain.

Factors	Neurogenic	Vascular
Evaluation after walking	Increased weakness	Unchanged
Palliative factors	Bending over, sitting	Stopping
Provocative factors	Walking downhill Increased lordosis	Walking uphill Increased metabolic demand
Pulses	Present	Absent
"Shopping cart" sign	Present	Absent
van Gelderen bicycle test	No leg pain	Leg pain

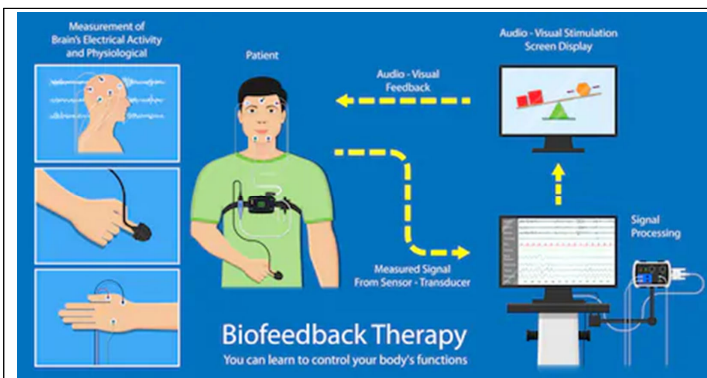


- Transcutaneous electrical nerve stimulation (TENS) is the use of electric current produced by a device to stimulate the nerves for therapeutic purposes.
- TENS, by definition, covers the complete range of transcutaneously applied currents used for nerve excitation although the term is often used with a more restrictive intent, namely to describe the kind of pulses produced by portable stimulators used to reduce pain.

TENS is often used for pain control and is an acronym for:

- A. Tension simulator
- B. Toxic epidermal necrolysis syndrome
- C. Ten stimulation modes
- D. Transcutaneous electrical nerve stimulation

- TENS = Transcutaneous electrical nerve stimulation.
- A portable device that utilizes electrical stimulation for pain control.
- Presumed to decrease pain via the gate controlled theory of pain.



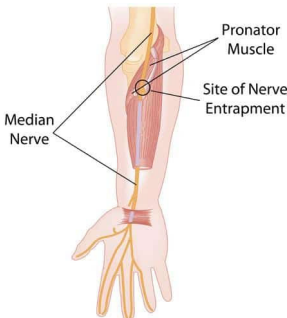
- Biofeedback is a technique you can use to learn to control some of your body's functions, such as your heart rate. During biofeedback, you're connected to electrical sensors that help you receive information about your body.
- This feedback helps you make subtle changes in your body, such as relaxing certain muscles, to achieve the results you want, such as reducing pain. In essence, biofeedback gives you the ability to practice new ways to control your body, often to improve a health condition or physical performance.
- Types of biofeedback: brain waves, breathing, heart rate, muscle contraction, sweat gland activity, temperature

This therapeutic technique uses many forms of both auditory and visual physiologic monitoring in an attempt to educate patients to alter physiologic functions that are usually not under conscious control. This technique has been used in chronic pain conditions, including headaches, low back pain, and fibromyalgia.

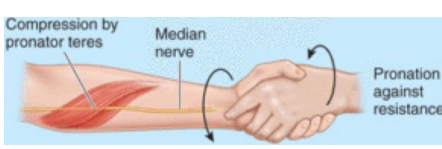
- A. Pilates
- B. Yoga
- C. Biofeedback
- D. Tai chi

#### Biofeedback

- Uses many forms of both auditory and visual physiologic monitoring in an attempt to educate patients to alter physiologic functions that are usually not under conscious control
- This technique has been used in chronic pain conditions, including headaches, low back pain, and fibromyalgia
- A commonly used form of biofeedback in chronic pain is EMG biofeedback, but there are other types.

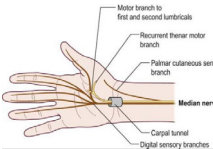


Pronator Muscle  
Site of Nerve Entrapment  
Median Nerve



Compression by pronator teres  
Median nerve  
Pronation against resistance

Sensation over Thenar eminence	
Carpal Tunnel syndrome	Pronator syndrome
normal	abnormal



Motor branch to first and second lumbricals  
Recurrent thenar motor branch  
Palmar cutaneous sensory branch  
Median nerve  
Carpal tunnel  
Digital sensory branches

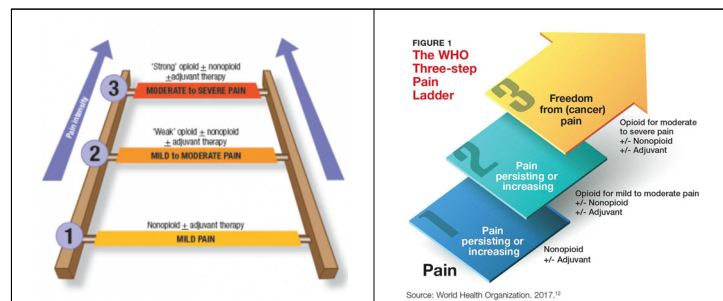
- Decreased sensation over a patient's thenar eminence is an indication of a median nerve injury that is proximal to the carpal tunnel. The sensation of the thenar eminence receives its nerve supply by a branch of the median nerve, which is proximal to the carpal tunnel, the palmar cutaneous branch of the median nerve

A patient presents with pain and paresthesias in the first three fingers of the hand and the skin over the thenar eminence. The pain does not awaken the patient at night. Pain can be provoked by resisted elbow flexion and pronation, as well as by resisted finger flexion. You make the diagnosis of:

- Carpal tunnel syndrome (CTS)
- Pronator syndrome
- C5 radiculopathy
- C8 radiculopathy

#### Pronator syndrome

- Refers to median nerve compression as the nerve passes between the two heads of the pronator teres.
- It often mimics carpal tunnel syndrome (CTS), as it presents with numbness over the first three digits.
- Whereas pain in CTS patients can wake patients from sleep, pain from pronator syndrome usually does not.
- Weakness is seen in median nerve innervated muscles distal to the pronator teres.



The World Health Organization (WHO) recommends a three-step "ladder" for cancer pain relief. In which order should pain medication be administered?

- Mild opioids → Nonopioids → Strong opioids
- Strong opioids → Mild opioids → Nonopioids
- Nonopioids → Mild opioids → Strong opioids
- Mild opioids → Strong opioids → Surgical intervention

#### Three-step "ladder" for cancer pain relief by WHO

- Nonopioids, mild opioids, then strong opioids should be the progression until the patient is free of pain.

**18.1** CASES  
MILLION of cancer/year

**9.6** DEATHS  
MILLION from cancer/year

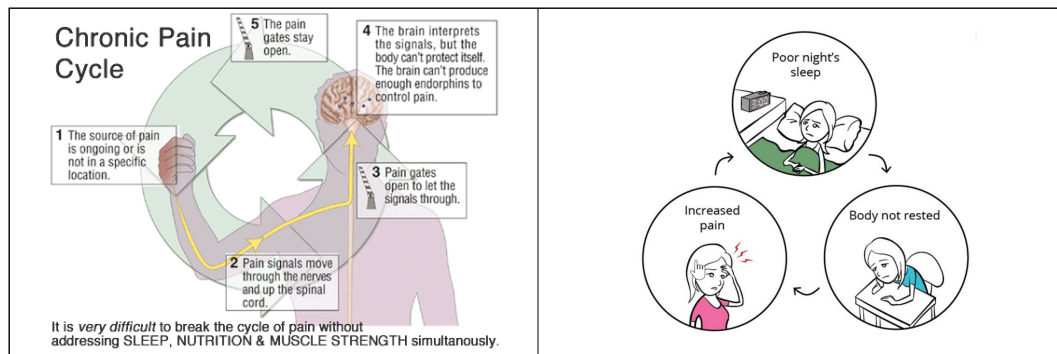
**1/6** DEATHS  
is due to cancer

**PAIN** is an unpleasant sensory and emotional experience associated with actual or potential damage of tissues. Individuals experience and express pain differently.

**55%**  
of patients  
undergoing  
treatment  
for cancer  
experience pain

**66%**  
of patients who  
have advanced  
metastatic  
or terminal  
cancer  
experience pain





Patients with chronic pain can display:

- A. Sleep fragmentation
- B. Difficulty falling asleep
- C. Decreased quality of sleep
- D. All of the above

#### Chronic pain and Sleep

- Studies have shown that patients suffering from chronic pain can suffer from:
  - ☐ sleep disturbances
  - ☐ ↑time to fall asleep
  - ☐ sleep fragmentation
  - ☐ ↓quality of sleep



Goal of chronic pain management



Improvement in functional status

What is the goal of chronic pain management?


- A. Enable people with pain to function better and enjoy daily activities
- B. Decrease the use of medications
- C. Eliminate pain
- D. Help people with pain return to their previous work

#### Goal of chronic pain management

- To help people with pain **function better** and live rewarding lives.
- Often the pain can be reduced, but not eliminated.

	LU	LI	ST	SP	HT	SI	UB	KD	PC	SJ	GB	LV
FIRE POINT	10	5	41	2	8	5	60	2	8	6	38	2
WATER POINT	5	2	44	9	3	2	66	10	3	2	43	8

YIN-YANG BALANCING ACUPUNCTURE (平針 평침)

		Ipsilateral		Contralateral	
		FIRE	WATER	FIRE	WATER
SYSTEM 1					
SYSTEM 2					
SYSTEM 3					
SYSTEM 4					

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