

Central Nervous System

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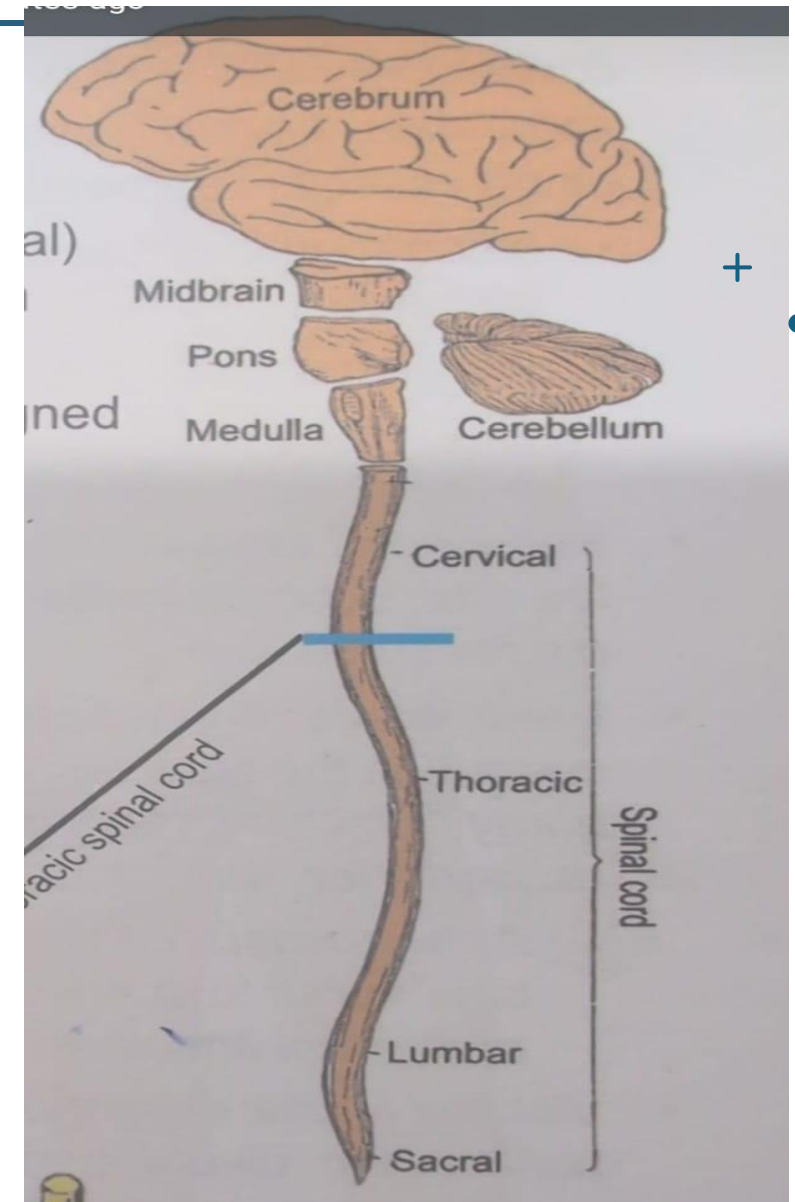
What is the Central Nervous System?

The **Central Nervous System (CNS)** consists of:

- **Brain**
- Brainstem
- **Spinal Cord**

Functions

- Controls movement
- Processes sensory information
- Coordinates reflexes
- Regulates autonomic functions
- Controls thinking, speech, and emotions



Peripheral Nervous System (PNS)

- Includes **all nerves outside the brain and spinal cord**. Connects the CNS to muscles, organs, skin, and glands.

Carries:

- **Sensory (afferent)** signals to the CNS.
- **Motor (efferent)** signals from the CNS to the body.

Spinal Nerves: 31 pairs of spinal nerves:

- 8 Cervical (C1–C8)
 - 12 Thoracic (T1–T12)
 - 5 Lumbar (L1–L5)
 - 5 Sacral (S1–S5)
 - 1 Coccygeal (Co1)
- Named according to the vertebral level where they exit the spinal column.
 - **Example: L3** = Third lumbar spinal nerve.



Cranial Nerves

- **12 pairs** of cranial nerves.
- Connect **directly to the brain**.
- Numbered using **Roman numerals I–XII**.
- Responsible for:
 - Special senses (vision, hearing, smell, taste)
 - Facial movement and sensation
 - Eye movements
 - Swallowing and speech
 - Autonomic functions of head and neck



Functional Division Of PNS

1. **Somatic Nervous System (SNS) – Voluntary Control**

- Controls **skeletal muscle contraction**
- Carries **sensory information** from the skin, muscles, and joints to the CNS
- Responsible for **voluntary movements** and conscious sensations

Functions:

- Voluntary movement
- Touch, pain, temperature, and proprioception

2. **Autonomic Nervous System (ANS) – Involuntary Control**

- Regulates the function of **smooth muscle, cardiac muscle, and glands**.
 1. Sympathetic Division ("Fight or Flight")
 2. Parasympathetic Division ("Rest and Digest")

Sympathetic Division ("Fight or Flight")

- Increases **heart rate**
- Increases **respiration rate**
- **Decreases digestion**
- **Dilates pupils**
- Prepares the body for stress or emergencies
- **Origin:** Spinal cord levels **T1–L2**

Parasympathetic Division ("Rest and Digest")

- **Increases digestion**
- Decreases **heart rate**
- Decreases **respiration rate**
- **Constricts pupils**
- Conserves energy and promotes recovery
- **Origin:** Cranial nerves **III, VII, IX, X** and sacral spinal levels **S2–S4**



CNS Lesions

A **lesion** is an area of damaged nervous tissue.

Causes

- Stroke (CVA) :A **Cerebrovascular Accident (CVA)**, commonly called a **stroke**, occurs when the **blood supply to part of the brain is interrupted or when a blood vessel in the brain ruptures**. Without oxygen and nutrients, brain cells begin to die within minutes.
- Trauma
- Disease
- Birth injury

Damage results in:

- Sensory dysfunction
- Motor dysfunction
- Autonomic dysfunction
- **Severity depends on**
 - Cause
 - Location
 - Size of lesion



Common CNS Conditions

- The major CNS conditions include:
- Hemiplegia (Stroke)
- Multiple Sclerosis (MS)
- Parkinson's Disease (PD)
- Cerebral Palsy (CP)
- Spinal Cord Injury (SCI)



Progressive vs Non-progressive Conditions

Progressive

Parkinson's Disease

Multiple Sclerosis

Symptoms worsen over time

Ongoing disease process

Non-progressive

Hemiplegia

Cerebral Palsy

Spinal Cord Injury

Damage remains stable after injury

Symptom Severity

Severity varies greatly.

- Some patients:
- Recover completely
- Have mild disability
- Require walking aids
- Become wheelchair dependent
- Need lifelong assistance

Treatment should always be individualized.



Motor Dysfunction

Common motor problems include:

- Spasticity
- Rigidity
- Muscle weakness
- Flaccidity
- Resting tremor
- Intention tremor
- These affect mobility, posture, and daily activities.



Gait Abnormalities

Different CNS conditions produce different gait patterns.

Hemiplegia / Multiple Sclerosis

- Circumducted gait

Parkinson's Disease

- Bradykinetic gait
- Festinating gait
- Short shuffling steps
- Many patients use:
 - Cane
 - Walker
 - Wheelchair



Tissue Health Problems

Reduced movement leads to:

- Poor circulation
- Edema
- Reduced tissue nutrition
- Pressure sores (Decubitus ulcers)
- Skin breakdown



Contractures

- Muscles that remain shortened develop:
- Contractures
- Reduced ROM
- Joint stiffness
- Functional limitations
- **Example**
- Finger flexor contracture
→ Hand closes into a fist



Functional Contractures

- Not all contractures should be treated.
- Example:
- A hook-shaped hand may help the client:
- Operate an electric wheelchair
- Hold objects

RMT should avoid stretching functional contractures that improve independence.



Joint Health

- Lack of movement causes:
- Reduced synovial fluid movement
- Poor joint nutrition
- Joint stiffness
- Cartilage degeneration
- Reduced ROM



Postural Changes

- Long-term muscle imbalance may cause:
- Hyperlordosis
- Hyperkyphosis
- Forward head posture
- Scoliosis
- These further impair movement and function.



Secondary Musculoskeletal Problems

- Long-standing CNS disorders may lead to:
- Tendinitis
- Adhesive capsulitis
- Shoulder subluxation
- Shoulder dislocation
- Peripheral nerve compression
- Degenerative disc disease
- Osteoarthritis



Pain

Pain may be:

- **Primary**
- Directly caused by CNS damage
- **Secondary**
- Resulting from:
 - Muscle tightness
 - Contractures
 - Joint dysfunction
 - Poor posture
 - Overuse injuries



Sensory Dysfunction

Possible symptoms:

- Numbness
- Tingling
- Paresthesia
- Dysesthesia
- Complete sensory loss (SCI)
- Sensory loss increases injury risk.



Autonomic Dysfunction

- Autonomic problems may include:
- Excess sweating
- Abnormal secretions
- Poor temperature regulation
- Blood pressure instability
- Seen commonly in:
- Parkinson's Disease
- Multiple Sclerosis
- Spinal Cord Injury



Autonomic Dysreflexia

- A medical emergency seen mainly in:
- **Spinal Cord Injury**
- Signs:
- Sudden severe hypertension
- Sweating
- Headache
- Flushed skin
- Bradycardia
- Requires immediate medical attention.



Compensatory Changes

- The unaffected side often develops:
- Muscle hypertonicity
- Fascial restrictions
- Trigger points
- Tendinitis
- Overuse injuries

Emotional & Behavioral Changes

- Clients may experience:
- Depression
- Anxiety
- Emotional stress
- Personality changes
- Reduced confidence
- Social withdrawal

Massage therapists should provide compassionate care and emotional support.



Seizures

- Brain lesions may increase the risk of:
- Seizures

RMT should:

- Know client history
- Stop treatment if seizure occurs
- Follow emergency procedures

Speech Disorders

Dysphasia

- Difficulty producing speech
- The client knows what they want to say but cannot coordinate speech.

Aphasia

- Loss of language comprehension or ability to speak.
- Communication may require patience and simple instructions.

Bowel and Bladder Dysfunction

Possible symptoms include:

- Urinary incontinence (involuntary leakage of urine)
- Urinary retention
- Constipation
- Bowel incontinence
- These may affect positioning and treatment planning.



Massage Therapy Goals

Treatment aims to:

- Improve circulation
- Reduce muscle tension
- Decrease pain
- Improve tissue mobility
- Maintain ROM
- Reduce edema
- Improve comfort
- Enhance relaxation
- Improve quality of life



Massage Therapy Precautions

Avoid or modify treatment when:

- Pressure ulcers are present
- Acute inflammation exists
- Severe osteoporosis
- Deep vein thrombosis
- Autonomic dysreflexia
- Uncontrolled seizures
- Medical instability

Always obtain medical clearance when needed.



What is Spasticity?

- **Spasticity** is an **abnormally increased muscle tone (muscle tightness)** caused by damage to the **Central Nervous System (CNS)**.
- It occurs because the brain can no longer properly control the spinal motor neurons.
- **Normally**
 - Brain → sends signals to:
 - Contract muscles when needed
 - Relax muscles when needed
 - This balance produces **smooth, controlled movement**.



In Spasticity

- A lesion in the CNS causes:
- Loss of inhibition
- Alpha motor neurons become overactive
- Muscles stay tight
- Movements become stiff and uncontrolled
- **Simple formula**
- CNS lesion → Loss of inhibition → Excess alpha motor neuron firing
→ Muscle stiffness (spasticity)



Conditions that Cause Spasticity

Spasticity commonly occurs in:

- Stroke (Hemiplegia)
- Multiple Sclerosis (MS)
- Spinal Cord Injury (SCI)
- Cerebral Palsy (CP)

Main Characteristics

- The muscles become:
- Tight
- Stiff
- Difficult to stretch
- Difficult to move voluntarily
- Passive movement becomes difficult because the muscles resist stretching.

What happens during Passive Movement?

If the therapist moves the limb **opposite to the spastic pattern**

- ↓
- The limb resists movement.

Example:

- A flexed elbow resists being straightened.

If the therapist moves **into the spastic pattern**

- ↓
- The muscles may suddenly move excessively because the reflex assists the movement.
- The client cannot control either movement.

Patterns of Spasticity

The body usually develops predictable movement patterns.

There are two major patterns:

- Flexor Pattern
- Extensor Pattern

Upper Limb Flexor Pattern

- The arm is pulled into a bent position.
- Features:
- Head bends toward affected side
- Shoulder depressed
- Scapula retracted
- Shoulder internally rotated
- Shoulder adducted
- Elbow flexed
- Forearm pronated
- Wrist flexed
- Fingers flexed
- Thumb adducted

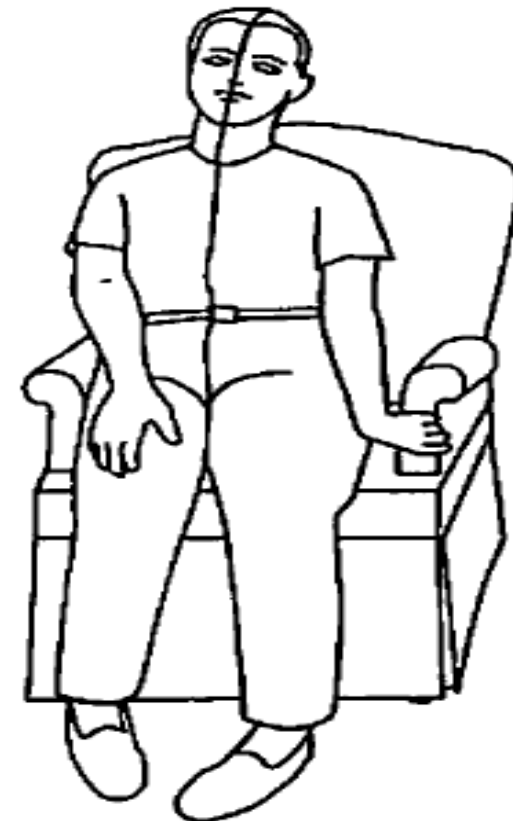
Flexor pattern, sitting



Upper Limb Extensor Pattern

Extensor pattern, sitting

- The arm becomes straight and rigid.
- Features:
 - Neck slightly extended
 - Trunk leans away
 - Scapula retracted
 - Shoulder internally rotated
 - Elbow extended
 - Forearm pronated
 - Wrist often flexed
 - Hand clenched into a fist



Lower Limb Flexor Pattern

- The leg bends.
- Features:
 - Hip flexion
 - Hip abduction
 - Hip external rotation
 - Knee flexion
 - Ankle dorsiflexion
 - Ankle inversion
 - Toe flexion

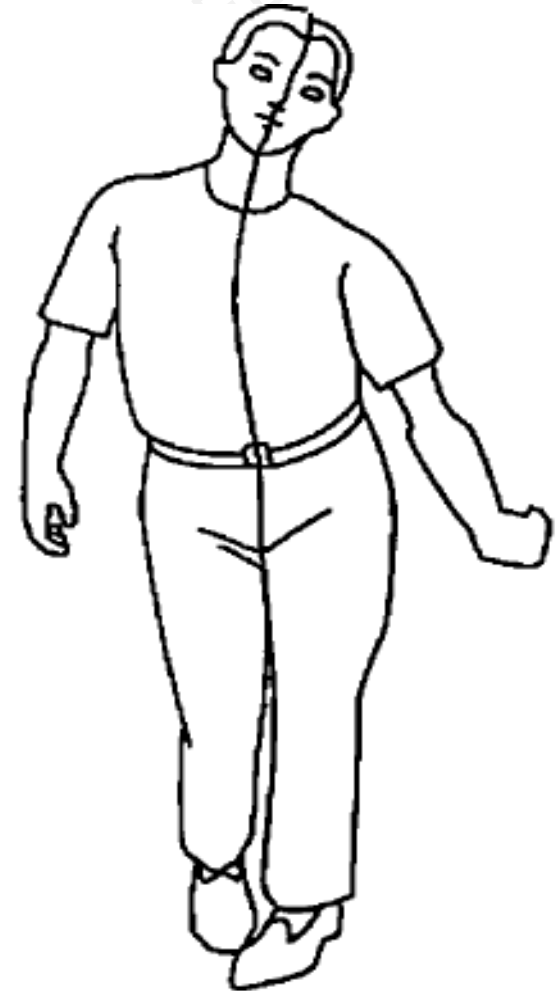


Flexor pattern, standing



Lower Limb Extensor Pattern

- The leg becomes stiff and straight.
- Features:
 - Hip extension
 - Hip adduction
 - Hip internal rotation
 - Knee extension
 - Plantarflexion
 - Inversion



Extensor pattern, standing



Factors that Increase Spasticity

- Spasticity changes throughout the day.
- It increases with:
 - Stress
 - Fear
 - Anxiety
 - Pain
 - Fatigue
 - Physical exertion
 - Increased autonomic nervous activity
 - Certain head positions
 - Touching certain body areas

Can Spasticity Ever Be Helpful?

Yes.

- Sometimes leg spasticity helps patients:
- Stand up
- Transfer from wheelchair
- Maintain posture
- Therefore:
- **Never assume reducing spasticity is always the treatment goal.**
- Always ask the client.



Techniques to Reduce Spasticity

- Each client responds differently.
- Use:
- Slow movements
- Gentle pressure
- Smooth rhythm
- Never force movement



Positioning

- Move joints **out of the spastic pattern.**
- Example:
- Upper limb:
- Head in midline
- Shoulder slightly protracted
- Shoulder externally rotated
- Elbow extended
- Wrist extended
- Fingers opened
- Towel roll placed in palm
- Lower limb:
- Hip flexed
- Knee flexed
- Hip slightly externally rotated
- Pillows for support



Rhythmical Shaking

Begin at:

- Fingers
- ↓
- Wrist
- ↓
- Elbow
- ↓
- Shoulder
- This often helps muscles gradually relax.



Passive Range of Motion (PROM)

- Move joints:
- Slowly
- Gently
- Without force
- If moved too quickly:
- Stretch reflex occurs
- ↓
- Spasticity increases.
- When resistance decreases:
- Continue gentle movement into the new available range.

RMT Precautions

- Never force a spastic limb.
- Avoid quick stretching.
- Support all joints.
- Work slowly and rhythmically.
- Watch for pain or increased tone.
- Ask the client what techniques work best for them.
- Obtain consent before trying to reduce spasticity, as some clients rely on it for functional activities like standing or transfers.



The image features a white background adorned with various autumn-themed elements. In the top left, there is a large, vibrant red maple leaf. To its right, a small cluster of blueberries and a single walnut are visible. Further right, a delicate branch with small, dried brown leaves is positioned. In the top right corner, a large, bright yellow maple leaf is displayed, accompanied by more blueberries. The bottom left corner features another large yellow maple leaf. Scattered throughout the bottom are several blueberries, a walnut, and small branches with dried leaves. The text "thank you" is centered in a black, elegant script font.

thank you