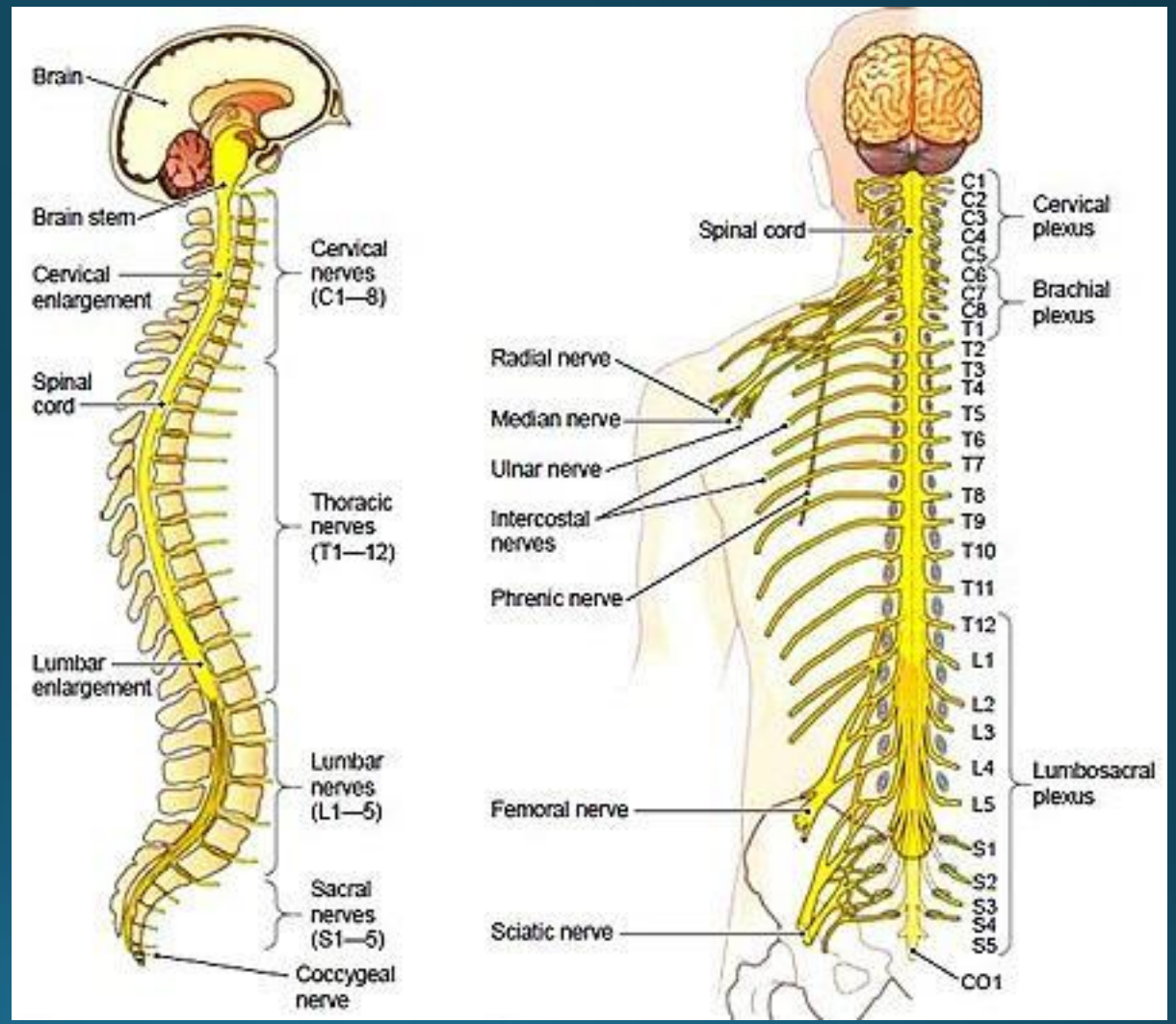
Neuro Muscular Connection

Spinal Injury Treatment

Spinal Nerves

- The spine is composed of 7 cervical, 12 thoracic, 5 lumbar, and 5 sacral vertebrae.
- Each vertebrae has a corresponding spinal nerve.
- **MYOTOMES**
  - The group of muscles that a specific spinal nerve innervates, or provides function to.



Spinal Cord Injuries (SCI)

- Trauma that results in bruising to the tissue of the spinal cord.
- Our bodies do not have way to repair and remove damaged cells from the spinal cord.

- American Spinal Injury Association (ASIA) classifies spinal injuries from A-E

A= Complete

B= Incomplete. Only sensory below injury.

C= Incomplete. Sensory + majority of muscles below injury have below grade 3 strength

D= Incomplete. Sensory + at least half of the muscles below injury are above grade 3

E= Normal

Grade A Spinal Injury- Severe cord compression and hemorrhage.

Reference: J Craniovertebr Junction Spine. 2011 Jan-Jun; 2(1): 17–26.

Laser Treatment and Myotomes

- The goal of laser treatment is to activate the spinal nerve that innervates the muscle or group of muscles which have lost function…

→ **Laser activates the myotome!**

- For simplicity we will explore the C5 myotome.

Example of C5 Laser Treatment

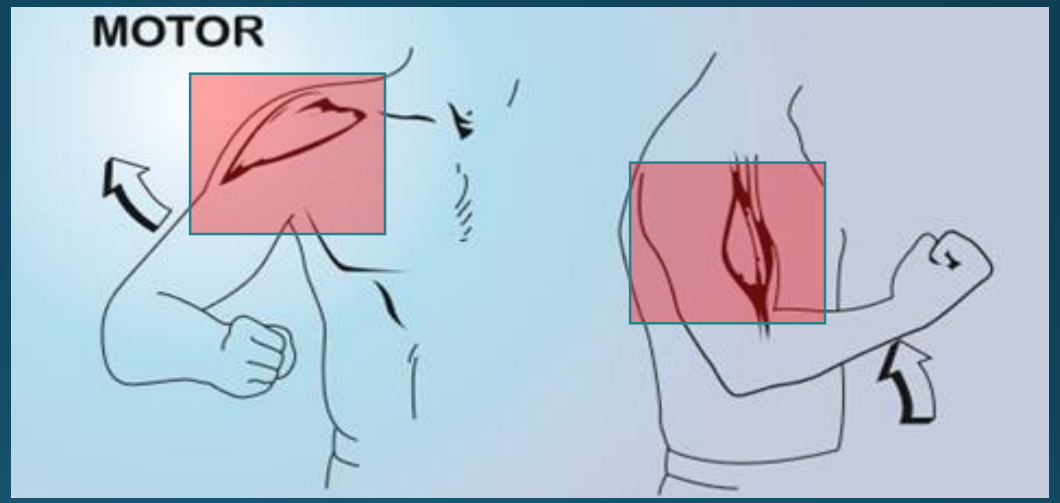
To measure the success of myotomal activation, **We Test…**

- Muscle Motor Function
- Joint Range of Motion (ROM)
- Muscle Amplitude
- Deep Tendon Reflex (DTR)
- Sensory Response at the skin

Motor Function

→ The C5 Myotome is associated with the

- Deltoid = Shoulder Abduction
- Biceps Brachii = Elbow Flexion



→ Motor function for these muscles is achieved by the brain voluntarily sending a message down the spinal cord to the C5 spinal nerve.

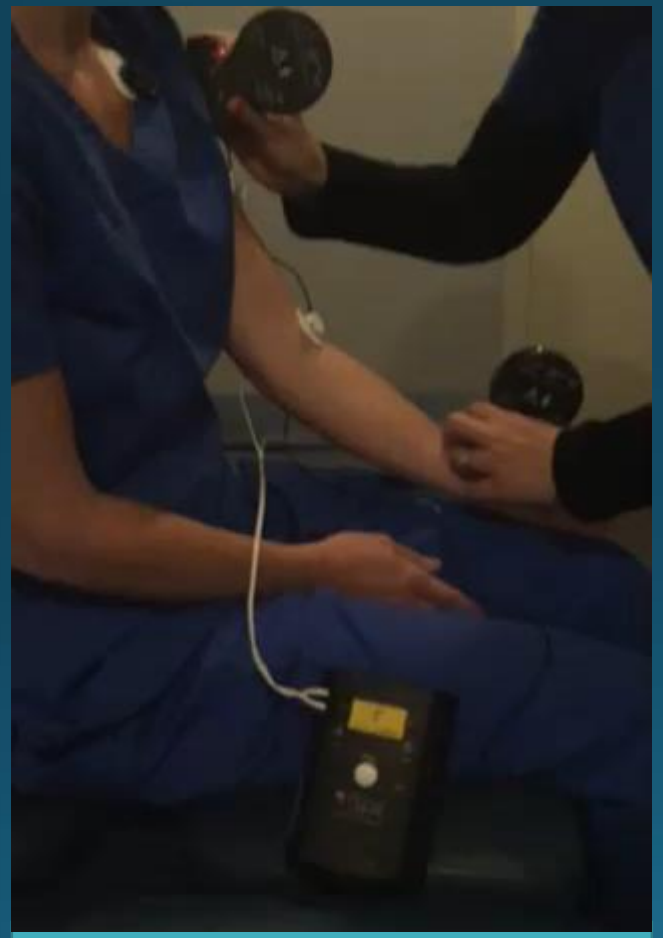
→ In SCI patients, the propagation of that message does not make it past the bruise on the spinal cord.

Motor Function is Measured by:

- Range of Motion (ROM):
  - The full potential movement of a joint in a specific direction, measured in degrees.
- Muscle Grading:
  - A subjective measure for assessing muscular strength. The therapist assigns a score from 0 to 5. When a 2 is reached, muscle force production measured used instead.
    - 0 = no palpable or observable muscle contraction
    - 5 = holds test position against maximal therapist-applied resistance
- Muscle Force Production:
  - The amount of force or effort produced by a muscle during a specific movement, measured in pounds using a hand-held dynamometer.
- Muscle Amplitude:
  - The amount of electrical activity produced by a muscle during a specific movement, measured using surface electromyography (sEMG). The signals can be analyzed to assess abnormalities in muscle firing. Measured in microvolts.

sEMG Software

- The most comprehensive objective measure for SCI patient improvement.
- Combines Muscle Amplitude with functional range of motion.
- Makes it possible to measure the muscular activity even when functional range of motion is limited.

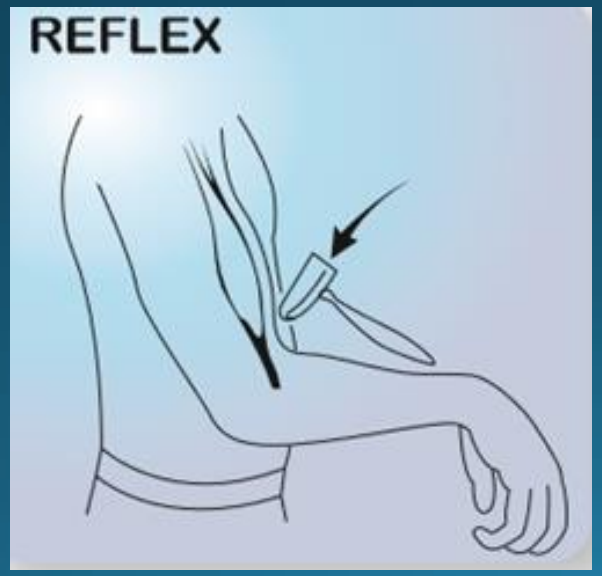


Myovision Bicep Example, Myotome C5

Patient Bicep Flexion, Myotome C5

Muscle Reflex

- → In addition to activating the myotome, we also activate the deep tendon reflex in order to promote muscle function.
- → Muscle Reflexes function independently of the brain.
- → When the reflex hammer hits the biceps tendon, it sends a looped message to the spine and back via the C5 spinal nerve.



Activating Biceps Brachii Tendon Reflex

Reflex Responses are Measured by:

Deep Tendon Reflex Test

→ The tendon is activated by the hammer, and the level of reflex response is noted:

0: no response,

1+: somewhat diminished/low

2+: average/normal

3+: brisker than average/possibly but not indicative of disease

4+: very brisk, hyperactive/often indicative of disease/ often associated with clonus (rhythmic oscillations between flexion and extension)

→ SCI patients tend to score 0-1+

Example of Biceps Brachii Deep Tendon Reflex Paired with Bicep Flexion

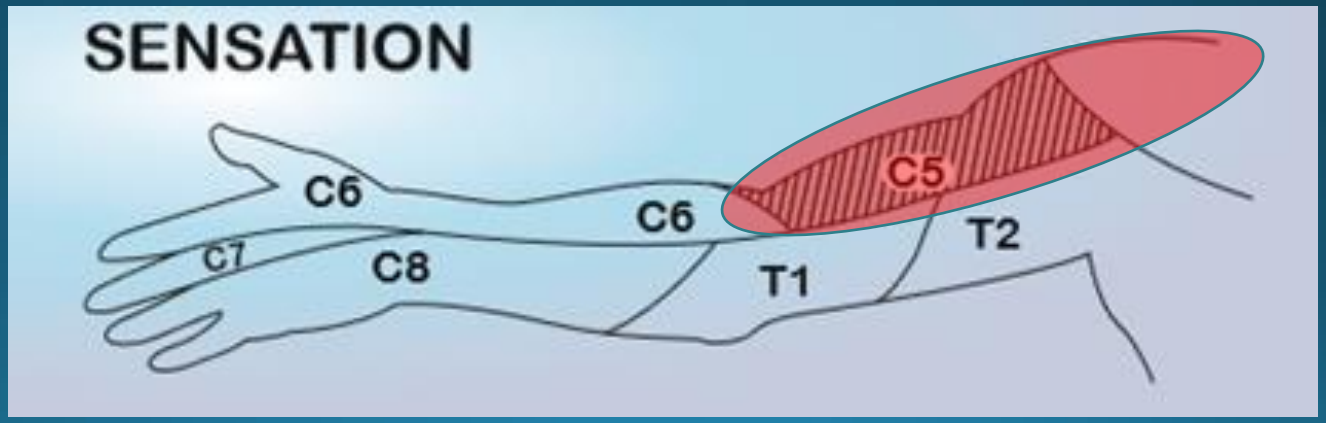
Sensation

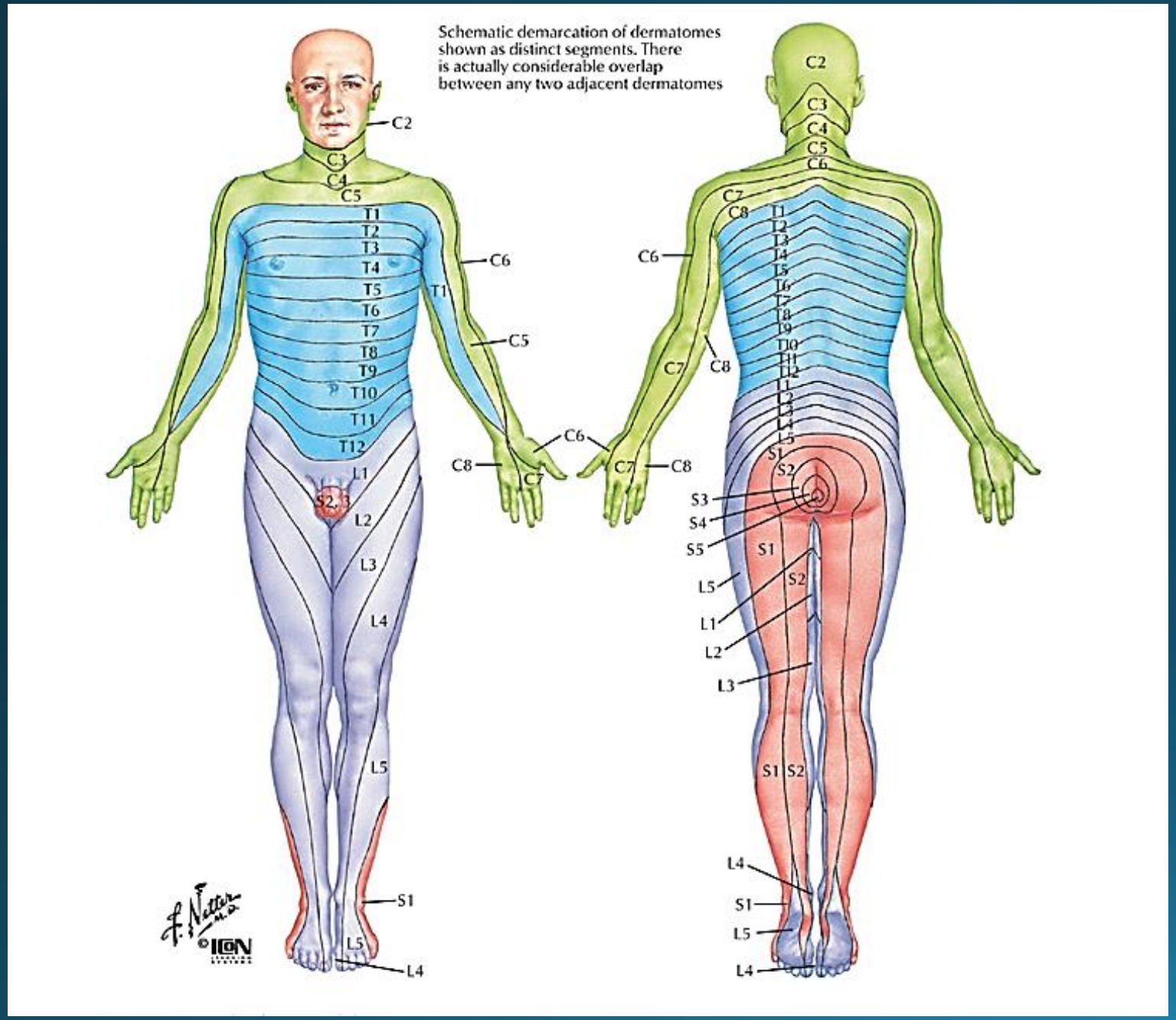
→ With SCI patients, we also assess their sensory perception at the skin.

Dermatomes

- A predictable area on the skin that is provided sensation by a specific spinal nerve.

Example:
C5 = Clavicles, lateral part of upper extremities.





Sensory Test

- Patient is asked to distinguish between light and crude touch (brush and toothpick) over select dermatomes.

Frequency of Patient Progress Exams

- A full assessment including the following exams will be completed one time per month for each SCI patient:

  - Muscle Grading and/or Muscle Force Production
  - Deep Tendon Reflex
  - sEMG/Active ROM
  - Sensory Response at Skin