

# **Match Each Muscle With Its Corresponding Motor Innervation. Each Term Can Be Used More Than Once. Be**

## **Match Each Muscle With Its Corresponding Motor Innervation. Each Term Can Be Used More Than Once. Be**

Understanding the intricate network of motor innervation to muscles is fundamental in anatomy, physiology, and clinical practice. Correctly matching muscles with their nerve supplies allows healthcare professionals to diagnose neurological lesions accurately, plan surgical interventions, and comprehend muscle function. This comprehensive guide aims to detail the primary motor innervations of key muscles, emphasizing their nerve origins and the pathways involved. Each muscle may share innervation with others or receive multiple nerve branches, hence the importance of recognizing common patterns and exceptions.

## **Fundamentals of Motor Innervation**

### **Definition and Importance**

Motor innervation refers to the nerve fibers that supply muscles with the signals necessary for contraction. These fibers originate from specific spinal or cranial nerve roots and traverse through peripheral nerves to reach their target muscles. Proper understanding of these pathways is crucial in localizing nerve injuries and understanding muscle function.

### **Types of Nerves Involved**

- Spinal Nerves: Emanate from the spinal cord, forming plexuses or directly innervating muscles.
- Cranial Nerves: Specifically, the motor component of cranial nerves innervates muscles of the face, head, and neck.

# Motor Innervation of Major Muscular Groups

## Muscles of the Head and Neck

### Facial Muscles

- Innervation: Facial nerve (Cranial Nerve VII)
- Key Muscles:
  - Orbicularis oculi
  - Orbicularis oris
  - Buccinator
  - Platysma
- Note: The facial nerve supplies muscles involved in facial expression, and each of these muscles is innervated directly by its terminal branches.

### Muscles of Mastication

- Innervation: Mandibular nerve (V3, a branch of the Trigeminal nerve, Cranial Nerve V)
- Key Muscles:
  - Masseter
  - Temporalis
  - Medial pterygoid
  - Lateral pterygoid
- Note: The mandibular nerve is responsible for muscles involved in jaw movement.

## Neck Muscles

### Innervation of the Sternocleidomastoid and Trapezius

- Sternocleidomastoid: Accessory nerve (Cranial Nerve XI)
- Trapezius: Accessory nerve (Cranial Nerve XI)
- Additional Innervation: Cervical spinal nerves C3 and C4 provide proprioception and some motor fibers.

## Muscles of the Back

### Erector Spinae Group

- Innervation: Dorsal rami of spinal nerves

- Key Nerves:
- Posterior branches of spinal nerves at respective levels

### **Deep Back Muscles**

- Include multifidus, rotatores, and semispinalis
- Innervated by dorsal rami of spinal nerves

## **Muscles of the Thorax and Abdomen**

### **Intercostal Muscles**

- Innervation: Intercostal nerves (ventral rami of thoracic spinal nerves T1–T11)
- Muscles:
  - External intercostals
  - Internal intercostals
  - Innermost intercostals

### **Abdominal Muscles**

- Innervation: Thoracoabdominal nerves (anterior rami of T7–T11) and subcostal nerve (T12)
- Muscles:
  - External oblique
  - Internal oblique
  - Transversus abdominis
  - Rectus abdominis

## **Motor Innervation of Limbs**

### **Upper Limb Muscles**

#### **Shoulder Muscles**

- Deltoid:
- Innervation: Axillary nerve (C5–C6)
- Supraspinatus and Infraspinatus:
  - Subscapular nerve (C5–C6) for subscapularis
  - Suprascapular nerve (C5–C6) for supraspinatus and infraspinatus

## **Biceps Brachii and Brachialis**

- Innervation:
- Musculocutaneous nerve (C5–C7)

## **Triceps Brachii**

- Innervation: Radial nerve (C6–C8)

## **Forearm Flexors and Extensors**

- Median nerve: Flexor muscles of the anterior compartment (except for flexor carpi ulnaris and ulnar half of flexor digitorum profundus)
- Ulnar nerve: Flexor carpi ulnaris and ulnar part of flexor digitorum profundus
- Radial nerve: Extensor muscles of the posterior compartment

## **Hand Muscles**

- Thenar muscles: Recurrent branch of median nerve
- Hypothenar muscles: Ulnar nerve
- Lumbricals:
- 1st and 2nd: Median nerve
- 3rd and 4th: Ulnar nerve
- Interossei: Ulnar nerve

## **Lower Limb Muscles**

### **Gluteal Group**

- Gluteus maximus: Inferior gluteal nerve
- Gluteus medius and minimus: Superior gluteal nerve

### **Thigh Muscles**

- Quadriceps femoris: Femoral nerve (L2–L4)
- Hamstrings:
- Biceps femoris (long head): Tibial part of sciatic nerve (L5–S2)
- Semitendinosus and semimembranosus: Tibial nerve (L5–S2)

### **Leg Muscles**

- Anterior compartment: Deep fibular (peroneal) nerve
- Lateral compartment: Superficial fibular nerve

- Posterior compartment: Tibial nerve

### **Foot Muscles**

- Innervated primarily by the tibial nerve (plantar muscles)
- Lateral and dorsal foot muscles have innervation from superficial and deep fibular nerves respectively

## **Special Innervation Patterns and Exceptions**

### **Muscles Sharing Innervation**

- Many muscles share nerve roots; for example, the muscles of the posterior thigh are innervated by the tibial nerve, a branch of the sciatic nerve.
- The muscles of the hand often have distinct innervations, such as the median and ulnar nerves, but some muscles receive overlapping supplies.

### **Muscles with Multiple Innervation Sources**

- Some muscles, like the levator scapulae, are innervated by dorsal scapular nerve and cervical nerve roots.
- The diaphragm is primarily innervated by the phrenic nerve (C3–C5) but has some accessory innervation from cervical plexus branches.

## **Clinical Relevance of Matching Muscles with Innervation**

### **Diagnosing Nerve Injuries**

- Recognizing which muscles are affected helps localize the level of nerve injury.
- For example, paralysis of the deltoid indicates axillary nerve damage.

### **Surgical Implications**

- Knowledge of innervation guides surgeons during procedures to avoid nerve damage.

### **Understanding Neurological Diseases**

- Conditions like peripheral neuropathies often impact specific nerve fibers, leading to muscle weakness or

paralysis in their supplied muscles.

## Summary Table of Major Innervations

- **Cranial Nerve VII:** Facial muscles (expression)
- **Cranial Nerve V3:** Muscles of mastication
- **Cranial Nerve XI:** Trapezius and sternocleidomastoid
- **Axillary Nerve:** Deltoid, teres minor
- **Musculocutaneous Nerve:** Biceps brachii, brachialis
- **Radial Nerve:** Triceps brachii, extensor forearm muscles
- **Median Nerve:** Forearm flexors, thenar muscles
- **Ulnar Nerve:** Flexor carpi ulnaris, ulnar part of flexor digitorum profundus, hypothenar muscles
- **Femoral Nerve:** Quadriceps femoris
- **Sciatic Nerve:** Hamstrings, all muscles of leg and foot via tibial and common fibular branches
- **Tibial Nerve:** Posterior leg, plantar foot

## Frequently Asked Questions

**Which nerve primarily innervates the biceps brachii muscle?**

The musculocutaneous nerve.

**Match the deltoid muscle with its motor innervation.**

The axillary nerve.

**Which nerve supplies motor innervation to the quadriceps femoris group?**

The femoral nerve.

**Identify the nerve that innervates the gastrocnemius muscle.**

The tibial nerve.

**The intrinsic muscles of the hand, such as the interossei, are mainly innervated by which nerve?**

The ulnar nerve.

## **Additional Resources**

Match Each Muscle With Its Corresponding Motor Innervation

Understanding the intricate relationship between muscles and their motor innervation is fundamental in anatomy, physiology, and clinical practice. Proper knowledge aids in diagnosing nerve injuries, understanding muscle function, and planning surgical interventions. This comprehensive review explores the key muscles, their innervations, and the clinical relevance of these relationships, providing a detailed map for students, clinicians, and anyone interested in neuroanatomy.

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## **Introduction to Motor Innervation**

Motor innervation refers to the nerve supply that stimulates muscle contraction, enabling movement. It involves the transmission of electrical impulses from the central nervous system (CNS) through specific peripheral nerves to target muscles. Each muscle is typically innervated by a specific nerve or nerve root, although some muscles may receive innervation from multiple sources.

The importance of understanding muscle innervation lies in its application:

- Diagnosing nerve injuries based on muscle weakness or paralysis.
- Planning surgical procedures to avoid nerve damage.
- Understanding reflex pathways and motor control.
- Recognizing patterns of innervation that help localize neurological lesions.

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## Overview of Major Nerve Sources

Before matching muscles, it's essential to familiarize with the main nerves involved in motor innervation:

- Cervical Plexus (C1-C4): Innervates neck muscles, some shoulder muscles.
- Brachial Plexus (C5-T1): Supplies muscles of the shoulder, arm, and forearm.
- Lumbar Plexus (L1-L4): Innervates anterior thigh muscles.
- Sacral Plexus (L4-S3): Supplies gluteal muscles, posterior thigh, and leg muscles.
- Other nerves: Cranial nerves (for muscles of facial expression, etc.), but mainly focus on spinal nerves for limb muscles.

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## Muscles and Their Innervation: A Systematic Approach

Given the extensive list of muscles, organizing them systematically—by region and nerve—is effective. The following sections delve into key muscle groups, their innervating nerves, and clinical correlations.

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## Neck Muscles

Sternocleidomastoid (SCM)

- Innervation: Accessory nerve (Cranial Nerve XI) and cervical spinal nerves (C2-C3).
- Function: Rotates and flexes the neck.
- Clinical note: Injury to the accessory nerve leads to weakness in turning the head toward the opposite side.

Prevertebral and lateral neck muscles

- Innervated by cervical plexus (C1-C4).
- Function: stabilize and move the cervical spine.

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## Shoulder and Axillary Muscles

Deltoid

- Innervation: Axillary nerve (C5-C6)
- Function: Abduction of the arm, anterior fibers flex and medially rotate; posterior fibers extend and laterally rotate.

Infraspinatus

- Innervation: Suprascapular nerve (C5-C6)
- Function: Lateral rotation of the arm.

Subscapularis

- Innervation: Upper and lower subscapular nerves (C5-C6)
- Function: Medial rotation of the arm.

Supraspinatus

- Innervation: Suprascapular nerve (C5-C6)
- Function: Initiates arm abduction.

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## Muscles of the Arm

### Biceps brachii

- Innervation: Musculocutaneous nerve (C5-C7)
- Function: Flexion of the elbow, supination of the forearm.

### Brachialis

- Innervation: Musculocutaneous nerve; also receives radial nerve fibers.
- Function: Flexes the elbow.

### Triceps brachii

- Innervation: Radial nerve (C6-C8)
- Function: Extension of the elbow.

### Coracobrachialis

- Innervation: Musculocutaneous nerve (C5-C7)
- Function: Flexion and adduction of the humerus.

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## Muscles of the Forearm

Divided into anterior (flexor/pronator) and posterior (extensor/supinator) compartments:

### Anterior compartment:

- Flexor carpi radialis, flexor carpi ulnaris, palmaris longus, flexor digitorum superficialis, flexor digitorum profundus, flexor pollicis longus, pronator teres, pronator quadratus
- Innervation: Mainly median nerve (C5-T1), with flexor digitorum profundus lateral part supplied by median nerve and medial part by ulnar nerve.

### Posterior compartment:

- Extensor carpi radialis longus/brevis, extensor digitorum, extensor carpi ulnaris, supinator, abductor pollicis longus, extensor pollicis longus/brevis, extensor indicis
- Innervation: Radial nerve (C5-T1).

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## Hand Muscles

- Thenar muscles (median nerve): Abductor pollicis brevis, flexor pollicis brevis, opponens pollicis.

- Hypothenar muscles (ulnar nerve): Abductor digiti minimi, flexor digiti minimi, opponens digiti minimi.
- Lumbricals: First and second lumbricals (median nerve); third and fourth (ulnar nerve).
- Palmar and dorsal interossei: Ulnar nerve.

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## Muscles of the Abdomen and Pelvis

Rectus abdominis

- Innervation: Thoracoabdominal nerves (anterior rami of T7-T11, subcostal nerve T12).

External oblique, internal oblique, transversus abdominis

- Innervation: Thoracoabdominal nerves, subcostal nerve.

Pelvic floor muscles (levator ani, coccygeus)

- Innervation: Pudendal nerve (S2-S4).

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## Gluteal Region Muscles

Gluteus maximus

- Innervation: Inferior gluteal nerve (L5-S2)
- Function: Hip extension, outward rotation.

Gluteus medius and minimus

- Innervation: Superior gluteal nerve (L4-S1)
- Function: Abduction and medial rotation.

Tensor fasciae latae

- Innervation: Superior gluteal nerve (L4-S1)

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## Posterior Thigh Muscles

Hamstrings group (biceps femoris, semitendinosus, semimembranosus)

- Innervation: Sciatic nerve (L4-S3)
- Biceps femoris (long head): tibial nerve; short head: common peroneal nerve.
- Semitendinosus and semimembranosus: tibial nerve.

Function: Hip extension, knee flexion.

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## Leg Muscles and Their Innervation

Anterior compartment (dorsiflexors, toe extensors):

- Tibialis anterior, extensor hallucis longus, extensor digitorum longus, fibularis tertius.
- Innervation: Deep fibular (peroneal) nerve (L4-L5).

Lateral compartment (fibularis longus and brevis):

- Innervation: Superficial fibular nerve (L5-S2).

Posterior compartment (plantarflexors, toe flexors):

- Gastrocnemius, soleus, plantaris, tibialis posterior, flexor digitorum longus, flexor hallucis longus.
- Innervation: Tibial nerve (L4-S3).

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## Foot Muscles

Divided into dorsal, plantar, and interosseous groups, all mainly innervated by the tibial nerve or the lateral plantar nerve.

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# Clinical Significance of Innervation Patterns

Understanding the nerve-muscle relationships is crucial in clinical settings. Here are some key points:

- Nerve injuries and muscle paralysis:
  - Damage to the axillary nerve causes weakness or paralysis of the deltoid, leading to inability to abduct the arm beyond 15 degrees.
  - Injury to the musculocutaneous nerve impairs flexion of the elbow due to weakness of biceps brachii and brachialis.
  - Radial nerve injury results in wrist drop owing to paralysis of wrist and finger extensor muscles.
  - Ulnar nerve lesions cause weakness in intrinsic hand muscles, leading to claw hand deformity.
  - Median nerve injury affects forearm flexors and thenar muscles, impairing thumb opposition and grip.
- Reflex testing: The innervation of muscles helps localize nerve lesions based on reflex responses, e.g., the biceps reflex tests C5-C6.
- Surgical planning: Knowledge of nerve pathways prevents inadvertent damage during procedures.

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## Summary Table of Key Muscles and Innervation

| Muscle | Innervation | Region | Function |
|--------|-------------|--------|----------|
| -----  |             |        |          |

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