Brachial Plexus Injuries

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Introduction

{1} The **brachialplexus** is a network of peripheral nerves that carries motor and sensory signals fromthe spinal cord to the **shoulder, arm, and hand**. Injury to the brachial plexus occurs when these nerves are **stretched, compressed**, or, in severe cases, tear in the spinal cord.

Brachial plexus injuries are mostly caused by **high-energy trauma**, such as **motor vehicle or motorcycle accidents**, and can lead to a wide range of symptoms, from **mild** sensory loss to complete **paralysis** of the upper limb. These injuries may cause significant functional impairment; however, early diagnosis and proper management can improve functional outcomes.

Anatomy of the Brachial Plexus

{2} The **brachialplexus**isformed inthe posterior triangle of the neck by the anterior ramiof spinalnervesC5–T1andis organizedinto roots, trunks, divisions, cords, and terminal branches.

Roots	C5–T1
Trunks	Upper (C5–C6), Middle (C7), Lower (C8–T1)
Divisions	Anterior & Posterior
Cords	Lateral, Posterior, Medial
Terminal Branches	Musculocutaneous, Axillary, Radial, Median, Ulnar

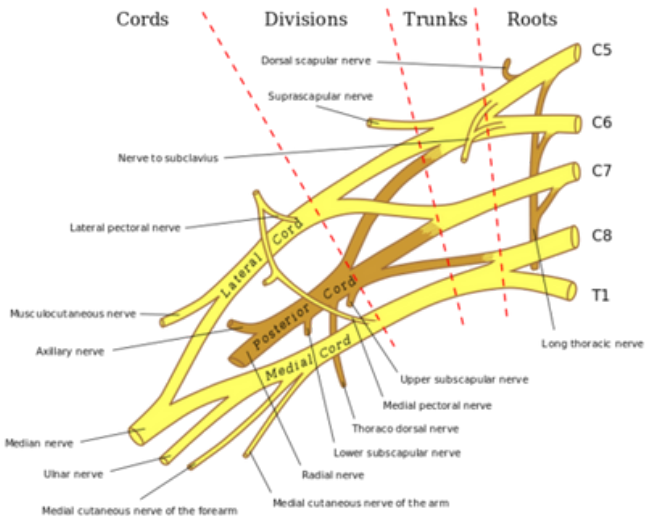

Figure 1. Brachial plexus anatomy.

Source: https://www.physio-pedia.com/Brachial_Plexus_Injury

Mechanisms and Causes of Injury and Types of Nerve Damage

{3} TheBrachialplexus injurieshappen whenthere'stoomuch**stretching, compression, tearing,or avulsion**onthe nerves . There's a lot of common causes like:

1- Road traffic accidents (especially motorcycle accidents)

2- Falls causing shoulder depression with neck traction

3- Obstetric trauma (difficult delivery)

4- Penetrating injuries (knife, gunshot)

5- Tumors or radiation

6- Inflammatory neuropathies

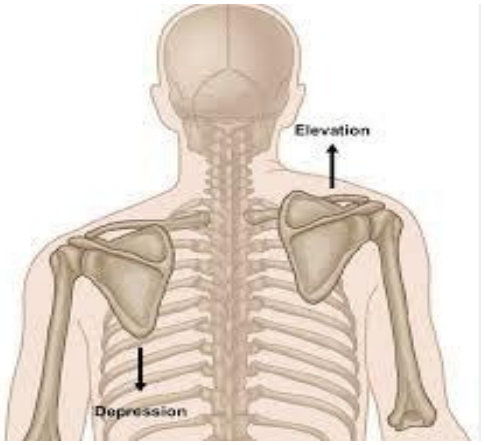

Figure 2. Brachial plexus injury illustration.
Source: https://share.google/IRCjrbw1KsBjfqCkO

Figure 3. Orthotic management of brachial plexus injury.
Source: https://share.google/jXqB5N7kK4i3BZ3Rh

Type		**Prognosis**
Neuropraxia	Temporary conduction block	Excellent
Axonotmesis	Axonaldamage with intact sheath	Good
Neurotmesis	Complete nerve disruption	Poor

{4}Classification According to Level of Injury:

UpperPlexus Injury(C5–C6)–Erb's Palsy

Mechanism: Excessive separation of headandshoulder

Musclesaffected: Deltoid, biceps, supraspinatus,infraspinatus

Clinical Presentation:

- Arm adducted and internally rotated
- Elbow extended
- Forearm pronated
- “Waiter’s tip” position

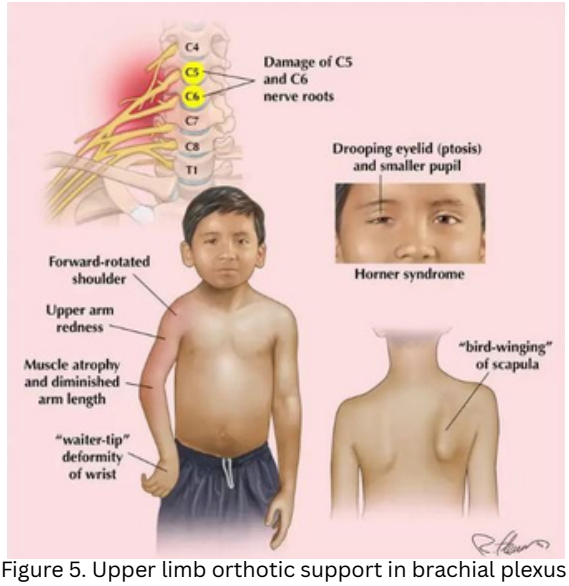

Figure 5. Upper limb orthotic support in brachial plexus injury.
Source: https://share.google/GYGHdg1yBysGqL7IB

Figure 4. Upper limb orthoses for brachial plexus injury.
Source: https://share.google/IELGCH0yCcRdmZMr6

Lower Plexus Injury (C8–T1) – Klumpke’sParalysis
Mechanism: Excessive arm abduction
Muscles affected: Intrinsic hand muscles
Clinical Presentation:

- Claw hand deformity
- Weak grip
- Sensory loss on medial forearm and hand
- ± Horner syndrome (ptosis, miosis)

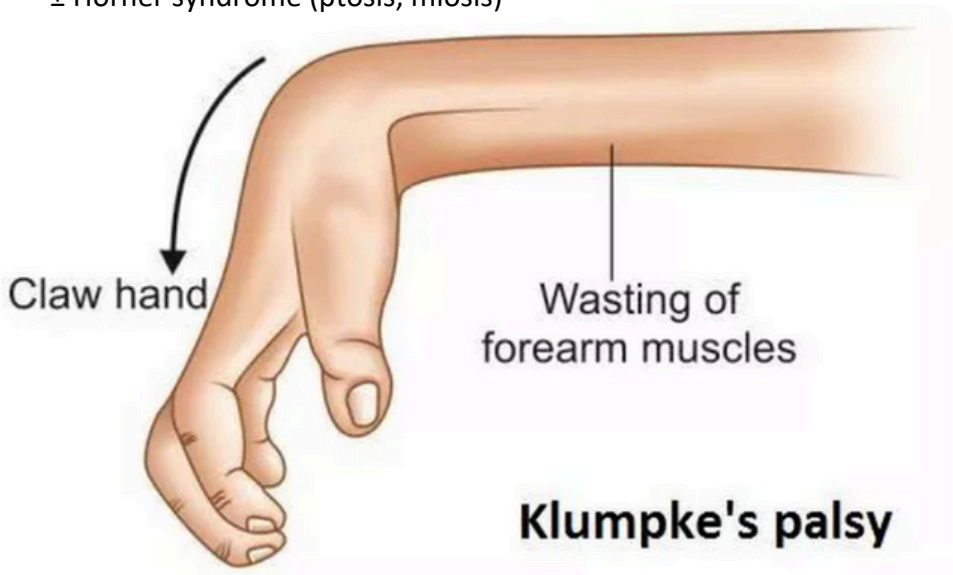

Figure 6. Clinical assessment of brachial plexus injury.
Source: https://share.google/5detYnyHrTikDOEQU

Total Brachial Plexus Injury (C5–T1)

Mechanism: Severe high-energy trauma

Muscles affected : All muscles of the upper limb

Clinical Presentation:

- Complete flaccid paralysis of the upper limb
- Total sensory loss
- Poor functional prognosis

Feature	**Erb's Palsy**	**Klumpke's Paralysis**	**Total brachial plexus injury**
Roots	C5–C6	C8–T1	C5–T1
Main deficit	Shoulder & elbow	Hand intrinsic muscles	Complete upper limb paralysis
Sensory loss	Lateral arm and forearm	Medial forearm and hand	Medial forearm and hand
Deformity	Waiter's tip	Claw hand	Flail upper limb
Prognosis	Generally good	Variable	Poor

{5}Clinical Evaluationand Diagnosis:

Patients with brachial plexus injuries may present with a wide range of clinical manifestations depending on the **level and severity of nerve involvement**. Common symptoms include **muscle weakness**, **sensory loss, abnormal limb posture**, and reduced functional use of the upper extremity.

- Inspection of limb posture and alignment
- Assessment of muscle wasting and deformities
- Muscle strengthtesting
- Sensory mapping
- Reflex assessment

Imaging and Diagnostic Tests

- **Magnetic Resonance Imaging (MRI):**
  Used to visualize the brachial plexus and identify severe injuries such as root avulsion or pseudo meningocele.
- **Electromyography (EMG) and Nerve Conduction Studies (NCS):**
  Provide information about the severity of nerve injury and help in determining prognosis.
- **X-ray:**
  Performed to detect associated fractures, particularly of the clavicle or cervical spine.

Figure 7. Clinical assessment of the upper limb in brachial plexus injury.
Source: https://share.google/1qhFSKvM4KVbVhDOn

Figure 8. MRI.
Source: https://share.google/Lo2ptZvVO0E1iDgEf

Figure 9. EMG.
Source: https://share.google/lw6ITCwRbO9EkBlYm

{6} Management Overview

Management of brachial plexus injuries varies according to several factors, including the **severity of the injury**, **the level of nerve involvement**, **the age of the patient, and the time elapsed since the injury**. An individualized treatment plan is essential to achieve the best possible functional outcome.

Conservative Management

Conservative treatment is usually the first-line approach, especially in mild to moderate injuries.

- Physical therapy to maintain muscle activity
- Range of motion exercises to prevent joint stiffness
- Pain management as needed

Early rehabilitation is important to preserve joint mobility and reduce the risk of secondary complications such as contractures.

Surgical Management

Surgical intervention may be considered in severe injuries or when there is no satisfactory recovery with conservative treatment.

- Nerve grafting to bridge damaged nerve segments
- Nerve transfer to restore critical functions
- Tendon transfer to improve limb function in chronic cases

Goals of Orthotic Intervention

- Prevention of joint contractures
- Support of weak or paralyzed muscles
- Improvement of functional limb positioning
- Enhancement of independence in daily activities

Common Orthotic Options

- **Shoulder abduction splints:** Used in upper brachial plexus injuries to prevent shoulder adduction contractures
- **Elbow support orthoses:** Assist in positioning and stability when elbow control is weak
- **Wrist-hand orthoses (WHO):** Maintain wrist extension and improve hand function
- **Anti-claw splints:** Used in lower plexus injuries to correct claw hand deformity
- **Functional arm orthoses**: Provide overall limb support in cases of severe or total plexus injury

Figure 10. AHOULDR ABD SPLINT
Source:
https://share.google/Lo2ptZvVO0E1iDgEf

Figure 11. Elbow support orthosis
Source:
https://share.google/Lo2ptZvVO0E1iDgEf

Figure 12. wrist hand orthosis
Source:
https://share.google/Lo2ptZvVO0E1iDgEf

Conclusion

Brachial plexus injuries represent a challenging condition due to their anatomical complexity and functional impact. A thorough understanding of anatomy, injury mechanisms, clinical syndromes, and rehabilitation strategies is essential. Orthotic management is not merely supportive but is a fundamental component of functional recovery, particularly in cases with delayed or incomplete nerve regeneration.

Reference

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