



Management of Traumatic Peripheral Nerve Injuries

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Purpose

Traumatic peripheral nerve injuries (PNIs) are significant contributors to morbidity following trauma, occurring in approximately 2–3% of trauma patients (Griffin et al., 2014; Padovano et al., 2020). The upper extremities, particularly the radial, median, and ulnar nerves, are most commonly affected, while the sciatic nerve predominates in lower extremity injuries. PNIs can result in chronic pain, motor and sensory deficits, and functional impairment, emphasizing the importance of early identification and management (Harhaus et al., 2024; Bateman et al., 2025).

This guideline provides evidence-based recommendations for the assessment, classification, operative timing, surgical techniques, and rehabilitation of PNIs.

Classification of Peripheral Nerve Injuries

PNIs are classified by the Sunderland system:

- **Neuropraxia (Type I):** Temporary conduction block with intact axon and connective tissue. Recovery is usually complete within days to weeks (Griffin et al., 2014).
- **Axonotmesis (Types II–IV):** Axonal disruption with varying degrees of connective tissue involvement. Type II injuries have intact endoneurium, Type III disrupts the endoneurium, and Type IV disrupts the perineurium. Type II often recovers spontaneously; Type III–IV injuries may require surgical intervention (Harhaus et al., 2024).
- **Neurotmesis (Type V):** Complete disruption of nerve and connective tissue; surgical repair is required for functional recovery (Yang et al., 2024).

Severity and Outcomes

Recovery correlates strongly with injury severity. Neuropraxic injuries have >90% full recovery. Axonotmetic injuries have 60–90% recovery depending on Type and extent. Neurotmesis outcomes depend on timely and proper surgical repair; untreated neurotmesis leads to permanent deficits (Buncke et al., 2021; Jonsson et al., 2013).

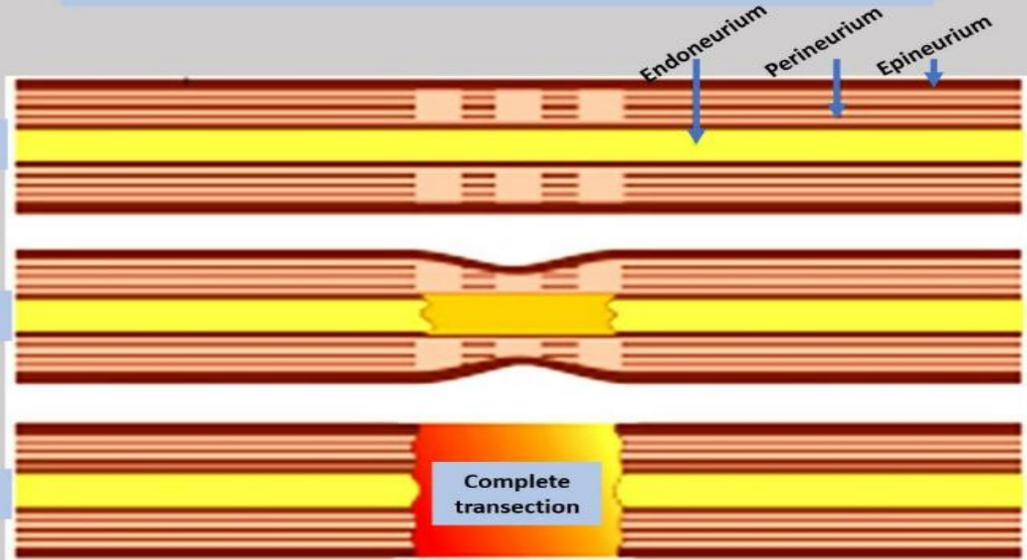


SEDDON'S CLASSIFICATION OF NERVE INJURIES

Neuropraxia

Axonotomesis

Neurotmesis



**Normal
peripheral
nerve**

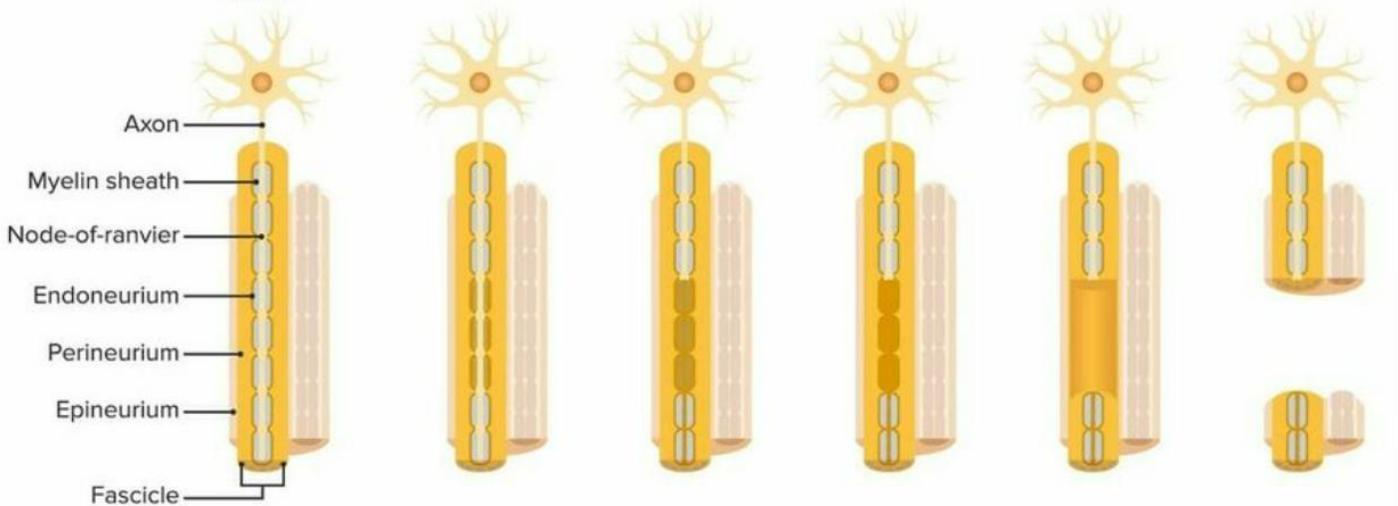
**Grade I
neurapraxia**

**Grade II
axonotmesis**

**Grade III
neurotmesis**

**Grade IV
neurotmesis**

**Grade V
neurotmesis**





Thomas and Ochoa, Birch and Bonney	Seddon	Sunderland	Pathology
Transient conduction block (non-degenerative)	Neurapraxia	I	Anoxia with recoverable disturbance of membrane potentials at molecular level
Prolonged conduction block (non-degenerative)	Neurapraxia	I	Distortion of myelin sheath
Degenerative (favourable prognosis)	Axonotmesis	II	Axonal disruption; basal lamina, endoneurium and perineurium intact
Degenerative (intermediate)	Axonotmesis	III	Axonal disruption; basal lamina and endoneurium damaged
Degenerative (unfavourable prognosis)	Axonotmesis	IV	Axonal disruption; endoneurium and perineurium damaged; epineurium intact
Degenerative (unfavourable prognosis)	Neuronotmesis	V	Loss of continuity of all elements of nerve

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Initial Assessment

- **Primary Survey:** Stabilize airway, breathing, and circulation as per ATLS guidelines (Gray et al., 2025).
- **Secondary Survey:** Perform a detailed neurological exam, documenting motor, sensory, and reflex deficits.
- **Imaging:** Use X-ray, CT, or MRI as indicated to evaluate for fractures, dislocations, or entrapment.
- **Electrophysiology:** EMG and nerve conduction studies (NCS) are recommended for injuries where physical examination is inconclusive (Kamble et al., 2019).

Management Strategies

Multisystem Trauma

- Life-threatening injuries take priority.
- Definitive nerve management may be delayed until the patient is hemodynamically stable (Randall et al., 2024).

Fractures with Nerve Injury

- Orthopedic consultation is mandatory.
- Fractures should be reduced and stabilized promptly to prevent further nerve damage.
- Evaluate nerve function intraoperatively; repair transected nerves immediately if feasible (Magnéli et al., 2024).



Open Injuries Requiring Surgical Exploration

- Address vascular injury, compartment syndrome, and fracture fixation first.
- Intraoperative exploration of the nerve should be performed; completely transected nerves should be repaired or tagged for future repair.
- Document unidentifiable injuries and ensure follow-up with a peripheral nerve specialist (Yang et al., 2024).

Closed Injuries

- Rule out fractures and compartment syndrome.
- EMG/NCS evaluation is recommended within 3–4 weeks.
- Surgical repair may be indicated 2–6 weeks post-injury if deficits persist (Murphy et al., 2023).

Timing of Nerve Repair

- **Optimal Timing:** Mixed nerves: repair ideally within 3 days. Pure sensory nerves: within 7 days (Wang et al., 2017; MacKay et al., 2021).
- **Delayed Repair:** Functional outcomes decline with delay; each month of delay decreases likelihood of good-to-excellent motor recovery by ~7% (Jonsson et al., 2013).
- **Outcomes by Severity:**
 - Neuropraxia: >90% recovery.
 - Axonotmesis Type II: 80–90% recovery; Type III–IV: 50–70% recovery.
 - Neurotmesis: <30% recovery without surgical repair; outcomes improve with timely end-to-end or graft repair (Buncke et al., 2021).

Operative Considerations

Primary End-to-End Repair:

- **Preparation:** Debride necrotic tissue, flex joints or shorten bones if needed for tensionless repair.
- **Approximation:** Minimal tension is critical; avoid extensive intrafascicular dissection.
- **Alignment:** Proper fascicular and rotational alignment is essential.
- **Maintenance:** Epineural repair with 9-0 or 10-0 sutures; immobilize postoperatively 10–14 days (Gray et al., 2025).

End-to-Side Repair

Used when direct coaptation is not feasible; involves attaching distal injured nerve end to the side of an uninjured nerve.

Grafting and Transfers

For gaps >2 cm or delayed repairs, autologous nerve grafts or nerve transfers improve functional outcomes (Yang et al., 2024; Buncke et al., 2021).

Rehabilitation

- **Immobilization:** 10–14 days; up to 6 weeks depending on injury severity.
- **Physical Therapy:** Gradual passive and active range of motion; strengthening exercises.
- **Pain Management:** Gabapentin or pregabalin for neuropathic pain.
- **Assistive Devices:** Braces or splints for limb protection and functional restoration (Silver, 2021).

Referral Criteria

Refer patients to specialized peripheral nerve centers for:

- Complete nerve transection or complex injuries.
- Persistent deficits despite appropriate initial management.
- Advanced reconstructive interventions, including nerve grafts or transfers (Lavorato et al., 2023).



Tracking and Quality Improvement

- Outcomes tracked through the trauma center's Performance Improvement Plan.
- Record: injury mechanism, classification, repair technique, timing, complications, and functional outcomes.
- Regular review ensures compliance and identifies areas for improvement (Bateman et al., 2025).

Version Control Record			
Version	Date	Author/Reviewer	Description of Changes
1	10/1/25	Paul Wisniewski, D.O.	Initial review and update to reflect latest evidence/practice

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