Radial Nerve Injuries Associated with Fractures of the Humerus

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The Injury

Primary nerve injury

Injury mechanism

Fall: most common mechanism

High energy: MVA, fall from height

Iatrogenic: surgical treatment of humerus/humeral ORIF

Compression/contusion

Secondary nerve injury (after reduction or manipulation of humeral shaft fracture)

Nerve may become incarcerated in the fracture after a reduction

Incidence

9-12% of fractures of the humerus (about 1 in 10)

Elkhom et al, JBJS, 2006

Shao et al, JBJSB, 2005

Fracture patterns

More common fracture patterns:

Spiral (OTA A1)

Transverse (OTA A3)

Open fractures

Comminuted patterns less common (OTA C1,2,3)
Fractures from the middle to the distal third of humerus most common for causing radial nerve palsy. Transverse and spiral fractures the most common types associated with nerve injury. (Shao et al, JBJSB, 2005)

High incidence of nerve entrapment or transection following open humeral fractures

9/14, Foster et al, JHS 1993
6/11, Ring et al, JHS 2004

**Nerve trauma**

Neuropraxia v. axonomesis

- Stretch or shear injury to the nerve: Most common
- Nerve entrapment in the fracture

Rarely complete neuromatosis

- Can occur from sharp bone ends lacerating nerve (high energy, open fracture)

**The Anatomy**

**Radial nerve in contact with the humerus**

- Mid-humerus, spiral groove
- Junction of middle third and distal third (pierces lateral intermuscular septum)
- Radial nerve most at risk in these locations
  
  Carlan et al, JHS, 2007

**Surface anatomy:**

- Radial nerve palpable along lateral border of the humerus
- Radial nerve at level of the lateral epicondyle to form posterior interosseous nerve
- Radial nerve innervates the brachioradialis muscle, 2cm proximal to lateral epicondyle
Nerve Injury and Recovery Assessment

**Diagnosis**

**Clinical**

**Motor assessment**

Brachioradialis and ECRL are the first muscles to recover, extensor indicis proprius is the last

**Sensory assessment**

Recovery of the superficial radial nerve sensation often delayed

**Advancing Tinel’s sign**

**Imaging**

**Ultrasound**

Can detect entrapment or radial nerve transection

**Electrophysiology studies**

EMGs findings indicative of nerve injury

- Fibrillation potentials
- Insertional activity
- Positive sharp waves, turns, polyphasic signals
- Reduced recruitment

**Timing of recovery**

Reinnervation occurs at 1mm/day with one month delay

Recovery would be expected ~ 4 mo. from injury, under “ideal” circumstances

**Non-surgical Treatment**

Monitoring for recovery of the radial nerve

Radial nerve palsy splinting, 8 hours per day to prevent contracture

Stretching exercises of the wrist and digits, daily

Electrical stimulation of extensor musculature of forearm.
**Surgical Treatment**

Recommended at 6 months if no clinical or EMG evidence of recovery

- Neurolysis if nerve/neuroma is intact and conducts
- Resection of damaged/non-conducting nerve segment/sural nerve graft reconstruction
- Primary repair: desirable, usually not feasible

**Tendon transfers**

1) Pronator teres to extensor carpi radialis brevis
2) Flexor carpi radialis to extensor digitorum communis to index, long, ring and small
3) Palmaris longus tendon to rerouted extensor pollicis longus.

**Outcomes**

Retrospective data demonstrates that radial nerve recovery occurs in 70% of cases, treated non-operatively.

Shao et al (JBJSB, 2005) showed no significant difference in final results when comparing non-operative management with early exploration.

No prospective studies available to compare results of tendon transfers v. radial nerve reconstruction.

Literature does not definitively support exploration over non-operative management for a secondary radial nerve palsy.
References

1) Bishop J, Ring D. Management of radial nerve palsy associated with humeral shaft fracture: a decision analysis model.