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 neruotomesis

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.

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