Chronic upper extremity overuse

- Tennis elbow
- Golfer’s elbow
- Ulnar neuritis
- Olecranon bursitis
- Radial tunnel syndrome
- Intersection syndrome
- Dequervain’s stenosing tenosynovitis
- Flexor tenosynovitis causing median nerve compression
- Digital flexor tenosynovitis
- Digital extensor tenosynovitis
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Most Common Referrals

- Wrist Tendinopathies
- Elbow Tendinopathies
- Finger stenosing tenosynovitis
- Repetitive stress/strain disorder


Total strain = strain (elastic) + strain (viscous)

1 sec load, 9 second recovery

8 second load, 2 second recovery
Armstrong et al, JHS, 1987
Ergonomics considerations in hand and wrist tendinitis

- Cross sectional study 652 workers
  - 4 cohorts (hi force and repetition, hi force low repetition, low force hi repetition, low force low repetition)
- High force, high repetition cohort odds ratio 29.5 versus low force, low frequency 1.0 (p < 0.001)
- Jobs adjusted odds ratio: women 4.3x more likely to develop tendinitis
- Hand and wrist posture and vibration exposure were not significant factors
- None of the non-occupational factors was significant (except for gender)
• Goals
  – Define the etiology and treatment of chronic overuse syndromes
  – Be able to provide a differential diagnosis and treatment options for these issues

Tendinopathies – Wrist Tenosynovitis

• Introduction
  – Most patients with wrist tendinopathy present with localizable, activity related pain
  – +/- history of injury, repetitive activity
  – Pain/functional limitation
• Introduction
  – Diagnosis often made on physical exam
  – Provocative maneuvers
  – Differential diagnosis
  – Radiographic studies often unnecessary
    • X-rays – Rule out bony etiologies
    • MRI – Rule out other soft tissue etiologies
      – Confirmatory – signal intensity changes about affected tendons (especially edema/fluid in T2 weighted images)

• Introduction
  – Treatment options generally include
    • Splinting/NSAIDS/OT
    • Corticosteroid injection(s)
    • Surgical releases

• Anatomy - dorsal compartments
  • 1st- APL & EPB
  • 2nd- ECRL & ECRB
  • 3rd- EPL
  • 4th- EIP & EDC
  • 5th- EDQ
  • 6th- ECU
• De Quervain’s Tenosynovitis
  – Stenosing tendovaginitis or tenosynovitis of the first dorsal extensor compartment:
    • Abductor pollicis longus tendons – 2 or more slips
    • Extensor pollicis brevis tendon
  – Extensor sheath becomes relatively stenotic or narrowed leading to pain and inflammation
• Anatomy
  – The anatomy of the first dorsal compartment is variable
  • EPB is absent in 5-7% of population
  • In 33% of population, the EPB tendon is separated from the multiple APL slips by a fibro-osseous tunnel or septum
  • Failure to recognize this variation can be a cause of treatment failure

• De Quervain’s
  Pathophysiology
  – Thick sheath over first dorsal compartment shows histologic changes, similar to pulley with stenosing tenosynovitis
  – Thickening of the sheath and accumulation of mucopolysaccharides have been seen

• De Quervain’s Tenosynovitis - History
  – More common in women (6:1 ratio)
  – Often occurs in new mothers and in later stages of pregnancy as an overuse of the thumb
  – Pain at the thumb base or radial wrist
  – Patients will sometimes complain of ‘clunking’ of the thumb – pseudo-triggering
• Finkelstein's test

• De Quervain's tenosynovitis
  – Differential diagnosis
    • Thumb CMC joint arthritis/instability
    • STT arthritis
    • Scapholunate ligament disruption
    • Radioscaphoid degenerative changes
    • Intersection syndrome

• De Quervain’s tenosynovitis
  – Treatment
    • Conservative
    • Operative
• Conservative Treatment for DeQuervain’s
  – Thumb spica splints – forearm based
  – Helpful for acute symptoms and in combination with other modalities
  – Shown in one prospective study to have a 70% failure rate long-term
  – In combination with NSAIDS
  – Occupational therapy- in combination with other modalities

• Corticosteroid Injections
  – Injection has been shown prospectively to resolve symptoms in 62% of patients
  – Risks of injection, however, must be considered
  – Generally limit number of injections (2-3 max)

• Risks of Steroid Injection into First Dorsal Compartment
  – Because of the very subcutaneous location of the tendons, higher incidence of:
    • Depigmentation
    • Fat necrosis/skin thinning
    • Subcutaneous tissue atrophy
  – In diabetics, short-term increase in blood glucose
  – Corticosteroid flare (pain after injection)
• DeQuervain’s of Pregnancy/Lactation
  – Thought due to the increased fluid shifts/edema secondary to hormonal fluctuation
  – Generally responds to splinting and corticosteroid injection
  – One study showed nearly 100% response to steroid injection, with less responsiveness to splinting – however, symptoms resolved at the end of lactation universally

• Surgical Treatment of DeQuervain’s
  – Indicated only after failure of conservative treatment
  – Division of the fibro-osseous sheath over the first dorsal compartment
  – Care must be taken to identify all slips of BOTH APL and EPB tendons

• Complications of Surgery for de Quervain’s Tenosynovitis
  – Injury to superficial radial nerve branches
  – Volar subluxation of the first dorsal compartment tendons
  – Incomplete release of tendon sheath due to a separate fibro-osseous tunnel/multiple slips of APL
• Intersection Syndrome
  – Pain and swelling due to entrapment of the second dorsal extensor compartment, which contains:
    • Extensor carpi radialis longus (ECRL)
    • Extensor carpi radialis brevis (ECRB)
  – Location is approximately where the first dorsal compartment tendons cross
  – Often seen in rowers and weightlifters

• Intersection Syndrome
  – Previously thought to be due to irritation of the crossing APL/EPB tendons over the wrist extensors
  – Studies at surgery show the problem is entrapment of the second dorsal compartment
• Intersection Syndrome - Evaluation
  – Tenderness to palpation over dorsal/distal/radial forearm
  – Some pain with wrist flexion/extension
  – Crepitation or “wet leather” feel over wrist extensors with wrist flexion/extension

• Intersection Syndrome - Treatment
  – Conservative
    • Splinting of the wrist - cock-up wrist splint
    • Corticosteroid injection(s)
  – Operative
    • Longitudinal incision to release the second dorsal compartment – retinaculum is left open

• Other Tendinopathies
  – EPL
    • Tendon entrapment rarely seen
    • Associated with wrist trauma (nondisplaced distal radius fractures), inflammatory arthropathy
    • Often leads to attritional rupture
      – Prior to rupture, tendon release and subcutaneous transposition above retinaculum may be preventive
      – If ruptured, reconstruction required to restore function (preferably EIP to EPL transfer)
• EPL tendon rupture after distal radius fracture

• Other Tendinopathies
  – ECU
    • One cause of ulnar sided wrist pain
    • May involve volar instability of the tendon (ECU snapping)
    • Generally responds to splinting and corticosteroid injection(s)
    • Debridement (and sheath reconstruction with a slip of retinaculum) helpful in refractory cases with instability

• ECU tendinopathy - MRI
ECU calcific tendinitis

• Other Tendinopathies
  – FCR – occurs due to inflammation in tight fibrous sheath at the wrist
    • Generally responsive to splinting, steroid injection
  – FPL – seen in rheumatoid patients due to inflammatory changes at distal scaphoid
    • If ruptured (Mannerfelt syndrome), tendon transfer (FDS ring) or thumb IPJ fusion needed to restore function

• Corticosteroid injection for FCR tendinopathy
• Summary
  – De Quervain’s tenosynovitis is more common in women and generally responds well to splinting and steroid injection
  – Surgical treatment is indicated for recalcitrant cases
  – Other tendinopathies are generally treated conservatively

Elbow Tendinopathies

• Lateral Epicondylitis
  – One of the most common overuse syndromes encountered in the upper extremity
  – Known as tennis elbow after being described by Morris in 1882 to be caused by lawn tennis
  – Tendinosis of the components of the extensor origin
• Epidemiology
  – 1-3% of population will experience lateral epicondylitis in their lifetime
  • Equal male/ female incidence
  • Usual onset between age 35-50

• Epidemiology
  – 5-10% can be attributed to playing tennis
  • 10-50% of regular players
  • Risk increases 2-3.5x playing > 2 hr/ week
  • Age > 40 increase 2x for women, 4x for men
  • Associated with hard surface, poor stroke mechanics, improper grip and racquet weight

• Epidemiology
  – Risk factors
  • Manual labor with heavy tools
  • Repetitive activities
  • Dominant arm
  • Poor coping mechanism
  • Depression
• Epidemiology: Natural History
  – 80% of newly diagnosed lateral epicondylitis will be symptomatically improved at one year
  – 4-11% patients will require surgery
    • Manual labor
    • Dominant arm
    • Poor coping mechanism
    • Longer duration of pain

• Epidemiology: Natural History
  – Long Term follow-up at 1 and 5 years (Binder and Hazelman Br J Rheum 1983)
    • 26% recurrence rate
    • 40% minor long term discomfort
  – Natural history confuses objective outcomes assessment of any treatment type

• Anatomy: Lateral Epicondyle
  – Serves as origin of
    • Extensor Carpi Radialis Brevis (ECRB)
    • Extensor Digiti Commninus (EDC)
    • Extensor Digiti Quinti (EDQ)
    • Extensor Carpi Ulnaris (ECU)
    • Superficial head of supinator (deep)
    • Lateral Collateral Ligament Complex (LUCL)
    • Anconeus
• Anatomy
  – Common extensor origin (CEO)
    • A confluence of the origins of the ECRB, EDC, EDQ, and ECU.
    • At epicondyle, fibers of the ECRB & EDC cannot be distinguished
  – ECRL has muscular origin proximal to epicondyle along supracondylar ridge

• Microanatomy: Lateral Epicondyle
  – Schneeberger and Masqualet (CORR 2002)
    • Microvascular anatomy in 12 elbows
    • Undersurface of ECRB origin is avascular
  – Bales et al (JSES 2007)
    • 6 cadaver elbows
    • 2 hypovascular areas of the common extensor origin
      – At the proximal lateral epicondyle
      – 2-3 cm distal to the undersurface of the ECRB origin

• Pathoanatomy
  – Lateral epicondylitis begins as a microtear
  – Inadequate healing response
  – Always involves the ECRB
    • Deep and more superior fibers
  – EDC involved in 35-50% of operative cases (Petrone and Nirschl)
• Pathoanatomy
  – Histologically proven tendinosis (Nirschl)
    • Disordered collagen
    • Mucoid degeneration
    • Angiofibroplastic hyperplasia
  – No inflammatory component

• Pathoanatomy
  – ECRB crosses both elbow and wrist
    • Under tension with elbow extended in all conditions of power grip
    • Leads to increased shear stresses at the origin (Briggs and Elliot, Arch Anat 1985)
  – ECRB undersurface rubs between outer edge of capitellum and ECRL with the elbow in extension (Bunata et al, JBS 2007)

• Clinical Presentation
  – Pain over the lateral aspect of the elbow
    • Localized at or just distal to epicondyle
    • Sharp/burning in nature
    • Radiation along course of wrist extensors
    • Worsened by active wrist extension or forearm rotation with elbow extended
  – Weakness of grip
  – Difficulty grasping or lifting items
Clinical Presentation
- Night pain present in severe cases
- Stiffness upon wakening may be described by patient
- Pain with even light daily activities
  - Shaving
  - Picking up coffee cup

Physical Examination
- Assessment of grip strength
  - Compare to unaffected side
  - Baseline objective measure of severity of lateral epicondylitis
  - Can be tested serially to assess response to treatment

Clinical Presentation
- Onset of pain is usually insidious
- Can be associated with repetitive activities
- Can be associated with acute traumatic episode
  - Direct trauma to lateral elbow
  - After lifting an object
Physical Examination

- Assess for warmth or erythema
- Point tenderness just distal and anterior to lateral epicondyle
- Examine for tenderness in radial tunnel

Assess anconeus triangle for synovitis or effusion

Physical Examination

- Assess ROM of elbow & shoulder
- Fluid elbow range w/o mechanical sx or clicking
- Limited shoulder IR leads to increased stress of ECRB with wrist flexion and lateral epicondylitis (Laban et al, Am J Phys Med Rehab 2005)
• **Physical Examination**
  – Pain with resisted wrist extension
  – Pain with resisted supination
  – Long finger extension test (RTS)
  – Pain with passive wrist and digital flexion

• **Physical Examination**
  – Pivot shift test (LUCL instability)
    • Forearm fully supinated
    • Valgus stress to elbow as it is moved from fully extended to flexed
    • Apprehension and rarely frank subluxation seen

• **Differential Diagnosis**
  – Cervical Radiculopathy
  – Radial Tunnel Syndrome
  – Intra-articular elbow pathology (11-69%)
    • Arthritis
    • Fracture
    • Synovitis
    • Loose body
    • Posterolateral plica
  – Posterolateral elbow instability
• **Differential Diagnosis:**
  Clues from patient history
  – Electrical symptoms
    • Radiculopathy
    • Radial tunnel syndrome
  – Clicking or locking
    • Mechanical joint derangement
  – Joint “apprehension”
    • Posterolateral joint instability

• **Differential Diagnosis**
  – Radial Tunnel Syndrome (RTS)
    • Compression of the posterior interosseous nerve (PIN) in the radial tunnel
    • Discomfort is vague
    • Tenderness on exam is supinator muscle
    • Occurs in 5-10% of pts with lateral epicondylitis
    • Can differentiate with diagnostic PIN blockade

• **Differential Diagnosis**
  – Posterolateral Plica (Ruch et al, *JSES* 2006)
    • 10 patients initially Dx’d with epicondylitis
    • Point of tenderness posterior to epicondyle at the posterior radiocapitellar joint
    • Subtle mechanical sxs (e.g., clicking)
    • Arthroscopic resection of the synovial plica led to complete resolution of sxs
• Imaging
  – Radiographs
    • Rule out intra-articular pathology
    • Radiocapitellar view
    • Calcification around extensor origin
  – Pomerance (JSES 2002)
    • 245 radiographs in LE patients
    • 16% incidence of abnormality seen
    • Findings influenced management in only 2 cases

• Imaging: MR findings
  – Edema and thickening of origin
  – Increased T2 signal
  – Extent of tendon involvement correlates with operative findings
  – May be negative

• Ultrasound findings
  – Hypoechogenic areas
  – Calcifications
  – Intrasubstance tears and thickening
  – Findings are moderately sensitive, but variably specific
  – Very dependent on operator’s experience
• Treatment Goals
  – Relief of pain
  – Enhance healing of ECRB
  – Most patients do not require operative treatment
    • Only 7% of patients required debridement (Nirschl and Petrone, JBJS 1979)
    • Only 5% treated operatively (Jobe and Ciccotti, JAOS 1994)

• Treatment
  – Activity modification
    • Limit lifting and repetitive grasping
    • Lifting with elbow flexed or forearm supinated need not be restricted
    • No vibrational tools
    • Equipment modification
      – Restring racquet
      – Change grip size
      – No gloves (they increase gripping force)

• Nirschl Exercises
  – Focuses on increasing strength, flexibility and endurance
  – Stretch wrist extensors with elbow extended
  – Progress to isometric and concentric strengthening
  – Resume activities with increasing duration
• Treatment: Non-operative
  – Physical Therapy
    • Cross friction massage
    • Eccentric strengthening
    • Ultrasound
    • Iontophoresis
  – NSAIDs (Oral and topical)

• Outcomes: NSAID’s
  – Green et al (Cochrane Review 2001)
    • Some evidence to support short term efficacy of topical NSAID’s
      – Decreased pain
      – Increased patient satisfaction
    • No evidence to support the efficacy of oral NSAID’s

• Treatment: Orthosis
  – Counterforce brace
    • Theoretically limit muscle expansion
    • Create a new more distal muscle origin
    • Less tensile stresses seen by injured tendon
  – Wrist cock-up splint
    • Diminishes contraction of the wrist extensors
• Outcomes: Orthotics
  – Struijs I (Cochrane Review 2002)
    • 5 RCT’s reviewed
    • No orthotic device was found to be superior to another
    • No benefit of orthotic seen when compared with other treatment (PT/NSAIDs/steroid injections)

• Treatment: Needles
  – Corticosteroid injection
  – Needle therapy without medication
  – Autologous blood injection
  – Acupuncture
  – Viscosuplementation
  – Botulinum toxin (Botox)

• Corticosteroid Injection
  – Treat the acute pain
  – Allow more rapid and pain free rehabilitation
  – Short term gains in pain relief seen, but no long term differences in outcome seen
• Corticosteroid Injection
  – Hay et al, BMJ 1999
    • RCT of 160 pts Rx’d with injection, naproxen or oral placebo
    • 4 week improvement 92%, 57%, and 50%
    • No significant difference in one year follow-up
  – Henket et al, ASSH 2007
    • RCT of 64 pts receiving corticosteroid or placebo injection
      – Injection did not improve pain relief or perceived disability at 1 or 6 months follow-up
      – Perceived disability correlated with measures of depression or poor coping mechanisms

• Corticosteroid Injection
  – Bisset et al, BMJ 1996
    • RCT of 196 pts receiving injection, 8 PT sessions, or “wait and see”
    • Injections had better outcome at 6 weeks, but higher recurrence rate and worse long term outcome
      – ECRB weakened?
      – Reinjured during pain free period?

• Local Needle Therapy
  – Altay et al, CORR 2002
    • RCT of 120 patients received corticosteroid injection vs injection of local anesthetic only
    • Repeated passes of needle (18 gauge)
    • 90% excellent results both groups at 2m and maintained through 1 year follow-up
• Autologous Blood Injection
  – Edwards and Calandruccio, JHS 2003
  • Injection of 2ml of blood in 28 pts
  • 79% totally relieved of pain at final follow-up
    – Response achieved by 8 weeks
  • 9 of 28 required 2 or 3 injections
  • Authors propose that the injection induces healing response through humoral and cellular mediators

• Acupuncture
  – May confer analgesia through modulation of beta endorphins
  – Effect can be blocked by naloxone

• Outcomes: Acupuncture
  – Green et al (Cochrane Review 2002)
    • Examined 4 randomized control trials
    • No evidence to support or refute the use of acupuncture for lateral epicondylitis
    • Needle acupuncture did appear to afford some short term pain relief (less than 24 hrs)
• Botulinum Toxin
  – Causes temporary muscle paralysis by presynaptic acetylcholine blockade
  – Hypothesis is that the paralysis allows torn ECRB muscle time to heal
  – 3 RCT’s reported

• Botulinum Toxin
  – Wong et al, Ann Int Med 2005
    • 60 patients single injection
    • Significant reduction in pain seen
    • No change in grip strength
    • Reversible weakness in finger extension observed

• Botulinum Toxin
  – Placzek et al, JBJS 2007
    • 130 patients received single injection
    • Improvement as early as 2 weeks
      – Clinical findings
      – Subjective patient assessment
    • No change in grip strength seen
• Extracorporeal Shock Wave Therapy (ESWT)
  – Utilized in other enthesopathies
  – Pulsed sonic waves dissipate energy at the interface of substances with differing acoustic impedance
  – Unclear mechanism of action
    • Blockage of nociceptors?
    • Increase cell permeability to induce repair?

• Outcomes: Shock wave therapy
  – Buchbinder et al (Cochrane Review 2005)
    • 9 RCT with 1006 pts vs placebo
      – ESWT offered little or no benefits with respect to pain or function
    • 1 RCT with 93 pts vs steroid injection
      – Steroid injection was more effective than ESWT

• Surgical Treatment
  – Indicated for patients who fail 6-12 months of conservative therapy
  – Usually only 4-11% of people will require surgical intervention
  – Long history of multiple techniques with good results
• Surgical Treatment
  – Techniques
    • Resection of epicondyle
    • Resection of annular ligament (Bosworth)
    • Distal tendon lengthening (Garden 1961)
    • Joint Denervation
  – Current trends in treatment shaped by understanding of the pathologic tissue involved

• Surgical Treatment
  – Open debridement of the extensor origin
    • With or without epicondylectomy
    • Need for arthrotomy?
  – Percutaneous extensor tendon release
  – Arthroscopic debridement

• Open Tendon Debridement
  – Lateral incision over and just distal to epicondyle
  – Incision of fascia in line with fibers
  – Identification of the pathologic fibers of the ECRB (+ EDC)
  – Resection of the diseased tissue
• Open Tendon Debridement
  – Some authors will drill or decorticate epicondyle to induce new blood supply
    • No benefit of drilling (Khasaba, *Br J Sports Med* 2001)
  – Repair the ECRB to epicondyle (Jobe)
  – Allow the ECRB to lengthen without direct repair (Nirschl and Pettrone)
    • Feel it is densely adherent to ECRL

• Open Tendon Debridement
  – Nirschl & Pettrone, *JBJS* 1979
    • 88 pts
    • 97.7% improved
    • 10-12% with minor pain
  – Kerlan-Jobe Clinic
    • 60 pts
    • 94% dramatic improvement
    • 36% limited with heavy lifting
    • 15% grip strength deficit
    • 100% had deficit on isokinetic testing

• Percutaneous Release
  – Area of epicondyle infiltrated with local anesthesia with epinephrine
  – 11 blade used to sweep around the anterior surface of the epicondyle
  – Keeps dissection less than 5 mm
  – Progress inferiorly until palpable defect felt
  – Patient selection
    • Landmarks obscured on larger arms
• Percutaneous release
  – Dunkow et al, JBJS Br 2004
    • Prospective RCT of 47 elbow open versus percutaneous release
      – Percutaneous Release
        » Higher patient satisfaction
        » Better DASH scores
        » Improvement in sporting activities
        » RTW 3 weeks earlier

• Arthroscopic Debridement
  – Feasibility described by Kuklow and Baker in Arthroscopy (1999)
  – Insufflate joint with 30 cc saline
  – Proximal medial portal first placed
  – Proximal lateral portal placement guided by the pathology
  – Can address concomitant articular pathology

• Arthroscopic Debridement
  – Arthroscopic shaver used to debride frayed capsule and then release the torn ECRB
  – Arthroscopic burr can be used to decorticate lateral epicondyle
• Arthroscopic Debridement  
  – Baker et al, JSES 2002  
  • 42 pts  
  • 95% rated as better or much better at final follow up  
  • Grip strength 96% of contralateral side  
  • Average RTW 2.2 week  
  • 69% had intra-articular pathology

• Arthroscopic Debridement  
  – Peart et al, AJO 2004  
  • Compare 42 open to 29 arthroscopic debridement by a single surgeon  
  • 70% good/ excellent at 6 months in both  
  • Return to work faster in arthroscopic group (2.9 versus 1.7 months)

• Outcomes: Surgical Treatment  
  – Lo and Safran, CORR 2007  
  • English literature for outcome of surgery (33)  
  – Only 2/33 articles had level I evidence  
  – Only 1/33 articles had level II evidence  
  – 28/33 were level IV evidence  
  • “…no technique appears superior by any measure. Therefore, until more randomized, controlled trials are done, it is reasonable to defer to individual surgeons regarding experience and ease of procedure. “
• Outcomes Surgical
  – Szabo et al, *JSES 2006*
    • Retrospective comparison of open, arthroscopic and percutaneous treatment
    • No significant difference seen in any outcome measure or time to recovery
    • Intra-articular pathology addressed in 44% of arthroscopic cases

• Complications
  – Iatrogenic posterolateral instability
  – Fistula
  – Neuroma of the posterior cutaneous nerve
  – Reactive bone formation
  – Injection
    • Skin hypopigmentation
    • Fat atrophy

• Failed Surgery
  – Re-assess diagnosis
    • RTS
    • Posterolateral instability (Hastings)
    • Posterolateral plica
  – Consider revision surgery
    • Organ et al, *Am J Sports Med 1997* found high % of incomplete excision of pathologic tissue
    • Radial tunnel release?
    • Coverage with anconeus flap
• Lateral Epicondylitis: Summary
  – Common source of elbow pain
  – Results from tendinopathy involving the origin of the ECRB
  – Differential diagnosis must be considered
  – Conservative management is usually successful
  – Operative management reserved for patients who fail of conservative management

• Medial Epicondylitis
  – An overuse syndrome
    • Most common cause of medial elbow pain
    • Also known as “golfer’s elbow”
  – Originally described by Morris in 1882
  – Tendinosis of the flexor pronator origin

• Epidemiology
  – Prevalence of 0.3% in population studies (Shiri et al, Am J Epidemiology 2006)
    • 5-7x less common than lateral epicondylitis
  – Slight male predilection (1.5-2:1)
  – Peak incidence: 3rd - 5th decade of life
• Epidemiology: Risk Factors
  – Sports (implicated in 10-20% of cases)
    • Golf, pitching, rowing, javelin, Tennis (serve)
  – Occupational
    • Forceful activities
    • Repetitive Motion
  – Other
    • Smoking
    • Obesity
    • Low social support

• Epidemiology: Natural History
  – Many believe, like lateral epicondylitis, medial epicondylitis has a significant rate of spontaneous resolution
  – Descatha et al, J Occ Environ Med 2003
    • Annual incidence of 1.5%
    • Prevalence 4-5%
    • 81% cure rate noted at 3 year follow-up

• Anatomy: Medial Epicondyle
  – Anterior face serves as the origin of
    • Pronator teres (PT)
    • Flexor carpi radialis (FCR)
    • Palmaris longus (PL)
    • Flexor digitorum superficialis (FDS)
    • Flexor carpi ulnaris (humeral head, FCU)
• Anatomy: Medial Epicondyle
  – Ulnar nerve in cubital tunnel
  – Medial collateral ligament
    • Main valgus stabilizer of elbow in flexion
    • Anterior oblique component is most important

• Pathoanatomy
  – Felt to be similar to lateral epicondylitis
    • Begins as a microtear
    • Inadequate healing response
  – Most commonly involves PT and FCR
  – FDS, PL, and FCU less commonly involved

• Pathoanatomy
  – Histologically proven tendinosis (Nirschl)
    • Disordered collagen
    • Mucoid degeneration
    • Angiofibroplastic hyperplasia
  – No inflammatory component
• Pathomechanics
  – Pitching
    • Valgus forces exceed tensile strength of medial muscle origin
    • Forces transmitted to muscles first and then the medial collateral ligament
    • Repetitive loads on the medial elbow can produce pathologic changes at the tendon origin that lead to tears

• Clinical Presentation
  – Onset of activity related pain over the medial elbow and proximal ulnar forearm
    • 60% occurs in dominant arm
    • 30% onset after acute trauma
    • 70% insidious onset
  – Pain worsened with repetitive, forceful forearm pronation and/or wrist flexion

• Clinical Presentation
  – Night pain present in severe cases
  – Stiffness upon wakening may be described by patient
  – Pain with even light daily activities
  – Pain can progress to pain at rest
• Physical Examination
  – Assess for warmth, erythema, swelling
  – Point tenderness at or just distal and anterior to palpable medial epicondyle

• Physical Examination
  – Assess ROM
    • Usually normal
    • No mechanical Sxs
    • Valgus instability
  – Assess Ulnar Nerve
    • Elbow flexion test
    • Tinel’s
    • Distal motor/sensory exam
    • Can coexist
    • Subluxating ulnar nerve

• Physical Examination
  – Pain increased with
    • Resisted wrist flexion
    • Resisted pronation
• Physical Examination
  – Assessment of grip strength
    • Compare to unaffected side
    • Baseline objective measure of severity of medial epicondylitis
    • Can be tested serially to assess response to treatment

• Differential diagnosis
  – Cervical Radiculopathy
  – Ulnar neuropathy at elbow (can co-exist)
  – Ulnar nerve subluxation
  – Snapping medial head of the triceps
  – Medial collateral ligament instability
  – Medial antebrachial cutaneous nerve neuroma
  – Elbow arthritis

• Differential Diagnosis:
  Clues from patient history
  – Electrical symptom
    • Radiculopathy
    • Ulnar neuropathy
    • Neuroma of medial antebrachial cutaneous n.
  – Clicking or locking
    • Mechanical joint derangement
  – Joint “apprehension”
    • MCL instability
• Imaging
  – Radiographs
    • Rule out intra-articular pathology
    • Calcification around flexor origin
    • Medial olecranon traction spur in throwers
    • Pomerance (JSES 2002)
      – 245 radiographs in LE patients
      – 16% incidence of abnormality seen
      – Findings influenced management in only 2 cases

• Imaging: MR
  – Only for challenging cases
    • Concomitant ligament injury
  – MR Findings (Kijowski and Desmet Skel. Radiol. 2005)
    • Thickening and edema in flexor origin
    • Increased signal on T2 most specific finding

• Ultrasound findings
  – Hypoechogenic areas
  – Calcifications
  – Intrasubstance tears and thickening
  – Findings are moderately sensitive, but variably specific
  – Very dependent on operator’s experience
• Treatment Goals
  – Relief of pain
  – Enhance healing of flexor pronator origin
  – Allow resumption of occupational and avocational activities
  – 90-95% of patients will respond to conservative treatment

• Treatment
  – Activity modification
    • Limit lifting, repetitive gripping and twisting
    • No vibrational tools
    • If possible, don’t use gloves
      – Increase the force required to control object
    • Change golf swing/tennis serve
      – Assessment by pro

• Nirschl Exercises
  – Focuses on increasing strength, flexibility and endurance
  – Stretch wrist flexors and pronator w/ elbow extended
  – Progress to isometric and concentric strengthening
  – Resume activities with increasing duration
**Medial Epicondylitis**

- **Treatment:** Non-operative
  - Physical Therapy
    - Cross friction massage
    - Eccentric strengthening
  - Ultrasound
      - Randomized double blinded placebo controlled trial for ME & LE
      - 6 Rx’s with dexamethasone
      - Better VAS pain scores at one month
      - Short term study

- **Medial Epicondylitis**

- **Treatment:** Non-operative
  - NSAIDS (Oral and topical)
    - Frequently used
    - Only topical NSAID’s shown to have ST efficacy in randomized controlled trials for lateral epicondylitis
    - Uncertain mechanism given lack of histological findings of inflammation

- **Medial Epicondylitis**

- **Treatment:** Orthosis
  - Counterforce brace
    - Theoretically limit muscle expansion
    - Create a new more distal muscle origin
      - Less tensile stresses seen by injured tendon
  - Wrist cock-up splint
    - Diminishes forceful wrist flexion
  - No studies prove efficacy
• Treatment: Corticosteroid Injection
  – Stahl & Kaufman, JBJS 1997
  – Prospective double blind placebo control; n=60
    • Steroid group significantly improved at 6 wk
    • No difference at 3m and 1 year
    • Short term benefit seen, but did not change long term natural
      history of the process
  – Beware of subluxing ulnar nerve
    (Stahl & Kaufman, JHS Br 1997)
  – Beware of medial antebrachial cutaneous nerve
    (Richards & Regan, Can J Surg 1989)

• Autologous Blood Injection
    • 20 patients with medial epicondylitis
    • Ultrasound used to confirm diagnosis and
      direct injection of autologous blood
    • Significant improvement 4 wk & 10 m
    • No control group
  – Success also reported in lateral
    epicondylitis
    • Edwards & Calandruccio, JHS 2003

• Treatment: Lessons
  from Lateral Epicondylitis
  – Needle injection without steroid
  – Shock Wave Therapy (ESWT)
    • Not helpful (Krischek et al, Arch Orhtop Trauma
      Surg 1999)
  – Botulinum Toxin
  – Acupuncture
• Surgical Treatment
  – Required for a small % of patients
    • Natural history favors improvement over a long time (> 1 y)
    • Residual symptoms can persist
  – Failure of non-op treatment for 6-12m
    • Exclusion of other causes of pain
    • Assessment of concomitant ulnar neuropathy

• Surgical Treatment
  – Current trends in treatment shaped by understanding of the pathologic tissue involved
    • Release of flexor pronator origin
    • Debridement of pathological tissue
    • Repair of tendon tissue +/- epicondylar reattachment or epicondylectomy

• Surgical Treatment
  – Open Tendon Debridement
    • Incision just anterior to medial epicondyle
    • Identify and protect MABCN
    • Fascial incison over PT/FCR interval
    • Complete resection of pathologic tissue
    • Protect anterior oblique component of collateral ligament
    • Repair of defect
      – No proven added benefit of epicondylectomy
• Surgical Treatment: Outcomes
    • 50 cases with 37m follow-up
    • All had partial or complete relief
    • 10/48 pts did not return to sport/occupation
  – Vangness and Jobe, JBJS Br 1991
    • 35 cases with 85m follow-up
    • 86% reported no use limitations
    • 97% Ex/G results

• Surgical Treatment: Medial Epicondylitis and Ulnar Neuropathy
  – Frequently co-exist
  – Outcomes limited by severity of pre-op ulnar nerve findings (Gabel and Morrey, JBJS 1995)
    • Consider epicondylar debridement and ulnar nerve decompression for mild neuropathy
    • More severe neuropathy requires nerve transposition
    • Recovery can take more than 6m in 1/3 of patients

• Complications
  – Injection
    • Ulnar nerve
    • Skin hypopigmentation
    • Fat atrophy
  – Surgical
    • Elbow instability
      – MCL injury
    • Ulnar nerve
      – Injury
      – Instability
    • MABCN neuroma
• Summary
  – Medial epicondylitis is a tendinopathy of the flexor pronator origin and a common cause of medial elbow pain
  – Diagnosis is usually possible by history and physical examination
  – Symptomatic relief seen in a majority with conservative treatment
  – Operative treatment is successful in those who fail conservative measures

Finger Stenosing Tenosynovitis – Trigger Finger

• Definition
  – Stenosing tenosynovitis is catching or locking of the finger (‘triggering’)
  – This occurs due to a size mismatch between the flexor tendon and the first annular (A1) pulley
• Anatomy of the Flexor Tendon/Pulley System

• Trigger Finger
  – Nodular, inflammatory enlargement of flexor tendons in the proximal aspect of digital sheath
  – Attempted gliding/pull-through of the tendon through the stenotic A1 pulley is impeded
  – The finger is thus “locked” in flexion
  – Often the finger must be passively extended with a palpable clunk

• Trigger Finger
  – Order of frequency of affected digits
    • Thumb most commonly seen
    • Ring or long finger second most common
    • Index finger
    • Small finger
• Primary or “idiopathic” trigger finger
  – Not associated with any disease process or activity
  – Most common
• Secondary: associated with a systemic disease
  – Diabetes
  – Rheumatoid arthritis
  – Amyloidosis
  – Sarcoidosis
• Infantile form – “congenital” trigger thumb

• Other Causes of Trigger Finger
  – Palmar aponeurosis pulley
    • A transverse condensation of palmar fascia proximal to the flexor sheath
  – Partial FDS laceration; cut slip of tendon “flaps” back and forth in tendon sheath with finger motion
  – Foreign body in tendon sheath

• Pathophysiology
  – Histology studies show fibrocartilaginous metaplasia of the A1 pulley
  – Inner gliding layer of the pulley primarily affected
• Diagnosis
  – Patients present complaining of “locking”, “clicking”, or “clunking” of the finger
  – Tenderness to palpation over the A1 pulley
  – Palpable tender nodule on the flexor tendon
  – Visualize “locked” finger with the PIP/DIP joints in flexion

• Diagnosis
  – Diagnosis most commonly made on physical exam alone
  – Radiographic studies unnecessary
    • X-rays – Rule out bony spur on metacarpal head
    • MRI – Rule out other soft tissue etiologies
      – Confirmatory - signal intensity changes about the flexor tendons (especially edema/fluid/partial tear in T2 weighted images)

• Treatment
  – Conservative
  – Operative
• Conservative Treatment
  – Splinting - hand or finger based splints in both gentle flexion and in extension (most commonly) have been described
  – Helpful for acute symptoms and in combination with other modalities
  – In combination with NSAIDS
  – Occupational therapy - in combination with other modalities
  – However, studies show steroid injection alone is more effective than splints

• Corticosteroid Injection(s)
  – 60-70% of nondiabetic trigger fingers can resolve after a single corticosteroid injection
  – The success rate in diabetics is less than 50%

• Injection Technique
  – Needle is placed at a 50-60 degree angle at the base of the digital flexor crease, through the tendons to bone.
  – Needle is slowly withdrawn, with forward pressure on the syringe until the injectate flows easily into the tendon sheath
Corticosteroid Injection in Diabetics
– Proven hyperglycemic effect of trigger finger injection
– Greatest effect 24 hours after injection
– Glycemic effect lasts up to 5 days
– Diabetics must be warned of this phenomenon prior to injection

Operative Treatment
– Indicated after failure of conservative treatment
– May be a first line treatment in diabetics, in patients with a locked finger that cannot be passively extended, or in those with contractures of the PIPJ (Green type IV)
– Release of the A1 pulley - allows free tendon gliding

Open A1 pulley release
– Transverse incisions in the midpalmar crease, oblique, or longitudinal incisions have all been described
– Division of the A1 pulley performed while protecting digital artery and nerve by retraction
• Open A1 pulley release - longitudinal incision

• Open A1 pulley release - longitudinal incision

• Complications
  – Bowstringing - due to inadvertent A2 pulley injury
  – Digital nerve injury (radial of thumb most common)
  – Recurrence or persistence of triggering
• Triggering despite A1 pulley release
  – Can occur in the chronic trigger finger
  – Constant triggering can cause chronic enlargement of the tendon, which continues to lock through the A2 pulley
  – Resection of the ulnar superficialis slip or removal of a central core of enlarged tendon (reduction flexor tenoplasty) can resolve the issue

Surgical Alternatives
  – Percutaneous release using needle or tenotome
  – Described as an office procedure using a 19-21 gauge needle to longitudinally divide the pulley
  – Complications include incomplete release, superficial tendon and digital nerve injury

Secondary Causes of Trigger Finger
  – Amyloidosis – seen in dialysis patients
    • Generally requires A1 pulley release and tenosynovectomy to remove amyloid deposits
  – Mucopolysaccharidosis – lysosomal storage disease which causes accumulation of glycosaminoglycans
    • Pulley release and tenosynovectomy usually needed
• Secondary Causes of Trigger Finger
  – Rheumatoid arthritis - triggering usually due to synovial inflammation
  – A1 pulley release is NOT INDICATED - this can cause volar drift due to the loss of the pulley
  – The treatment is tenosynovectomy, excision of bulbous tendon or rheumatoid nodules, excision of FDS slip

• Differential diagnosis - Locking MPJ
  – Occurs due to snapping of one of the collateral ligaments over a degenerative osteophyte on the metacarpal head.
  – In contrast to trigger finger, the digit position involves flexion posture of the MPJ with EXTENSION of the PIP/DIP joint
  – Treatment involves excision of the offending osteophyte

• Summary
  – Stenosing tenosynovitis is common and is usually treated initially conservatively in adults
  – Surgical treatment involves release of the A1 pulley
  – In patients with secondary triggering due to systemic disease, tenosynovectomy is often required
Compression Neuropathies: Median Nerve

• Median Nerve Anatomy
  – Originates from lateral and medial cords of the Brachial Plexus
  – Contains fibers from the C6, C7, C8 and T1 nerve roots and sometimes from C5.

• Median Nerve Anatomy
  – Travels down medial arm to the cubital fossa
  – Enters forearm medial to the brachial artery
  – Passes through the two heads of the pronator teres
  – Gives off no branches in the upper arm.
  – Give anterior interosseous branch as it passes under the pronator
• Median Nerve Anatomy: Muscles Supplied in Forearm
  – Median Nerve Proper
    • Pronator Teres (PT) Muscle
    • Flexor Carpi Radialis (FCR)
    • Palmaris Longus (PL)
    • Flexor Digitorum Superficialis (FDS)
  – Anterior Interosseous Nerve (AIN)
    • Flexor Digitorum Profundus (FDP) to index and long fingers
    • Flexor Pollicis Longus (FPL)
    • Pronator Quadratus (PQ)

• Median Nerve Anatomy Forearm
  – Passes between FDS and FDP
  – Gives off the palmar cutaneous sensory branch before it enters the wrist via the carpal tunnel
  • Runs radial to the median nerve and ulnar to the FCR tendon to provide sensation to the radial palm

Median Nerve Anatomy
• Median Nerve Anatomy - Sensation
  - Palmar aspect of thumb, index, long and radial half of ring fingers
  - Dorsal aspect of index, long and radial half of ring fingers distal to the PIP joint

• Carpal Tunnel Anatomy
  - Contents
    • Median nerve
    • FDP index-small
    • FDS index-small
    • FPL
  - Borders
    • Transverse carpal ligament (TCL)
      - Roof of carpal tunnel
      - Connects from the pisiform and hook of the hamate to the scaphoid tuberosity and triangular facets.
      - Ligament is confluent with antebrachial fascia of forearm
    • Carpus forms radial and ulnar borders and floor

• Median Nerve Anatomy
  - Variations in the take off of the motor branch of the median nerve
    • Distal to the ligament (extraligamentous)
    • Branching proximally and turning around the ligament distally (subligamentous)
    • Coursing through the ligament (transligamentous)
    • Rarely the motor branch comes off the ulnar aspect of the median nerve.
• Median Nerve Anatomy
  Muscles Supplied in Hand
  – Motor Supply (LOAF)
    • Lumbricals
      – Index
      – Long
    • Thenar Muscle
      – Opponens Pollicis
      – Abductor Pollicis Brevis
      – Flexor Pollicis Brevis
        (Superficial 1/2)

• Specific Motor Functions
  – Testing of FPL for anterior interosseous nerve lesion
  – Testing of Index FDP for anterior interosseous nerve lesion
  – Testing of Abductor Pollicis Brevis via palpation of APB with resisted opposition

• Sensory Testing
  – Threshold test
    • first measurable change in objective sensory perception
    • vibratory threshold and light touch
  – Density tests
    • test large myelinated fibers
      – static 2 point discrimination - slow adapting fibers
      – moving 2 point discrimination - fast adapting fibers
    • changes occur later than threshold tests
  – Subjective comparison

  Semmes Weinstein Monofilament
  Light Touch Testing
  Two Point Discrimination Testing
• Diagnostic Imaging Radiographs
  – Radiographic imaging not always required in diagnosis of carpal tunnel syndrome
  – May be helpful in cases of
    • Higher level lesions
      – Radiographs of the distal humerus can identify a supracondylar process in cases of pronator syndrome
    • Patients with past history of trauma
      – Radiographs of the wrist can identify old fractures of the distal radius, carpal instabilities, and wrist arthritis which may contribute to carpal tunnel syndrome.
    • Patients with inflammatory arthropathy

• Carpal Tunnel Syndrome
  – Most common compression neuropathy of the upper extremity
  – Etiology
    • Most cases are idiopathic
    • Women more than men
    • Incidence increases with age

• CTS - Systemic

<table>
<thead>
<tr>
<th>Rheumatoid arthritis</th>
<th>Hemophilia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>Multiple myeloma</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>Obesity</td>
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<tr>
<td>Gout</td>
<td>Renal failure</td>
</tr>
<tr>
<td>Amyloidosis</td>
<td>Pregnancy</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>Menopause</td>
</tr>
<tr>
<td>Alcoholism</td>
<td>Mucopolysaccharidosis</td>
</tr>
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</table>
• CTS - Mechanical

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cause</th>
</tr>
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<tbody>
<tr>
<td>Tenosynovitis</td>
<td>CMC arthritis</td>
</tr>
<tr>
<td>Ganglion</td>
<td>Fracture</td>
</tr>
<tr>
<td>Median artery</td>
<td>Acromegaly</td>
</tr>
<tr>
<td>Abnormal muscle</td>
<td>Tumor</td>
</tr>
</tbody>
</table>

• CTS - Pathophysiology
  – Normal pressure within carpal tunnel is 2.5 mmHg
  – Decrease in epineural blood flow and edema occurs with pressure 20-30 mmHg
  – Nerve conduction diminishes at pressures >30 mmHg
  – Continued or extended pressure elevation may result in complete median nerve block
• CTS - Symptoms
  – Numbness, paresthesia in median distribution
    • Increased at night or with work
    • Relief with dependency, shaking hand
    • May include ulnar digits
  – Palm, volar wrist
    • May involve dorsal MP area
    • May radiate to shoulder
  – Swelling of hand
  – Weakness, clumsiness, dropping objects

• CTS - Diagnosis

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phalen</td>
<td>10-88%</td>
<td>47-100%</td>
</tr>
<tr>
<td>Tinel</td>
<td>26-79%</td>
<td>40-100%</td>
</tr>
<tr>
<td>Durkan</td>
<td>87%</td>
<td>90%</td>
</tr>
</tbody>
</table>
| Semmes-Weinstein    | Up to 91%   | Up to 80%   | Palumbo + Szabo, Hand Clin, 18:269-77, 2002

Physical Examination - Tinel's sign
Physical Examination – Phalen’s test

• CTS - Electrodiagnosis
  – Motor latency 4.5 ms or 1 ms > opposite hand
  – Sensory latency 3.5 ms or 1 ms > opposite hand
  – Median-ulnar latency difference ≥0.5 ms

• CTS - Staging
  – Mild
    • Duration < 1 year
    • Intermittent numbness
    • Normal sensory testing
    • No weakness or atrophy
    • Minimal NCV changes, no denervation
  – Moderate
    • Continuous numbness, paresthesias
    • Increased threshold on sensory tests
    • Increased distal motor latency
  – Severe
    • Persistent loss sensory + motor function
    • Thenar atrophy
• CTS - Treatment
  – Nonsurgical
    • Initial treatment for most idiopathic cases
      – Splint
      – Corticosteroid injection
      – TVK B6
      – Diuretics
  – Surgical carpal tunnel release
    • Acute CTS
      – from trauma or infection
    • Chronic CTS
      – With denervation in APB
      – Pronounced sensory loss
      – Unresponsive to nonoperative measures
CTS – Predictors of Outcome with Conservative Treatment

• Factors – Age>50 yrs, Duration sx> 10 mo, Constant paresthesias, Stenosing tenosynovitis, Phalen’s + in <30 s (Kaplan et al, JHS 15B, 1990)

<table>
<thead>
<tr>
<th>Factors Present</th>
<th>% Success</th>
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<tbody>
<tr>
<td>0</td>
<td>66</td>
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<tr>
<td>1</td>
<td>40</td>
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<tr>
<td>2</td>
<td>17</td>
</tr>
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<td>3</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

• CTR – Anatomical Changes
  – 25% volume increase
  – Oval shape becomes circular
  – Median nerve larger, rounder, displaced palmarly
  – Guyon’s canal changes from triangular to oval

• Surgery – Open v Endoscopic
  – 2-3 week earlier return to work with endoscopic versus open CTR
  – No substantial difference in final outcome
    • Brown et al, JBJS (Am) 1993.
    • Trumble et al, JBJS (Am) 2002.
• CTR – Predictors of Outcome
  – Longterm failure
    • Weakness or atrophy of APB
    • Predisposing condition
    • No relief from initial steroid injection
  – Longterm success
    • 100% of those with >6 months relief from injection and splinting
      Kulick et al, JHS A 1986

• Proximal Median Compression
  – Cervical spine
  – Thoracic outlet
  – Forearm
    • Pronator teres
    • Sublimis
    • Lacertus fibrosis

• CTS – Double Crush Syndrome
  – 70% of 115 patients with proven entrapment neuropathy had evidence of cervical root lesion
  – “Neural function is impaired because single axons, having been compressed in one region, become especially susceptible to damage at another site.”
    Upton et al Lancet 2:359,1973
• AIN palsy - History
  – Dull pain proximal forearm
  – Often follows muscular exertion
  – Occasional direct trauma
  – Inability to pinch thumb and index

• AIN - Anatomy
  – Innervates FPL, FDP (IF+/−MF), PQ
  – Take off distal to PT in 90%
  – Martin-Gruber anastomosis from AIN in 7%
  – “Median hand” – all profundi from AIN
  – Compression from musculo-tendinitis anomalies (thrombosed vessels, bicipital bursa)

• AIN - Physical Exam
  – Isolated FPL or FDP (IF) in partial syndrome
  – Usual - FPL + FDP (IF) + PQ
    • + ulnar intrinsics if Martin-Gruber anastomosis
    • + FDP MF, RF, SF in “Median hand”
  – Tinel’s, tenderness at site
  – No sensory abnormality
AIN Syndrome – EMG/NCV
- Abnormal latency elbow to pronator quadratus (nl 5.1 ms +/-0.9 ms)
- 7/7 – Prolonged duration of action potential (Nakano, 1977)
- 18/22 – EMG findings of denervation (Hill, 1985)

Median Nerve Compression
- Differential Diagnosis - AIN
  - Complete
    • Neurogenic amyotrophy (Parsonage Turner)
      – Severe proximal pain
      – Serratus anterior, supra/infraspinatus, deltoid
    • Median compression in axilla (Spinner, 1976)
  - Partial
    • Tendon rupture (RA)
    • Stenosing or adhesive tenosynovitis – EMG nl, pain at site of pathology
• AIN - Treatment
  – Splint +/- NSAIDs
  – Explore unrelieved paralysis at 6-12 weeks

• AIN Syndrome – Outcome

<table>
<thead>
<tr>
<th>Reference</th>
<th>Recovery after surgery</th>
<th>Spontaneous recovery</th>
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</thead>
<tbody>
<tr>
<td>Spinner, 1970</td>
<td>6-12 weeks</td>
<td>3 wks-14 mo</td>
</tr>
<tr>
<td>Hill, 1985</td>
<td>8/24 @ 12; 16/24 @ 2 yrs</td>
<td>4 wks-2.5 yrs</td>
</tr>
<tr>
<td>Nakano, 1977</td>
<td>9-17 mo</td>
<td>3-18 mo</td>
</tr>
</tbody>
</table>

• PTS - History
  – Aching pain proximal forearm
    • Increased by repetitive pronation
    • Proximal +/- or distal radiation
  – Clumsiness
  – Tender mass
  – Occasional numbness, weakness
PTS – Sites of Compression
  – Pronator Teres (82%)
    • 50% fibrous band superficial to nerve
    • 40% fibrous band deep to nerve
    • 20% both
  – Superficialis origin (14%)
    • Fibrous arcade 30%
  – Lacertus Fibrosis (4%)

PTS – Physical Findings
  – Tender PT, +/- mass
  – Tinel’s
  – Phalen’s negative
  – Variable numbness
    • Median digits, palmar triangle
  – Variable weakness
    • FPL, median intrinsics
  – Pain, paresthesias with provocative tests

PTS – Electrodiagnosis
  – EMG/NCV often nl
  – May have segmental decrease motor conduction velocity at PT, denervation if severe
• PTS - Treatment
  – Job alteration
  – Long arm splint, NSAIDs
  – Steroid injection
  – Surgical decompression at all sites

• PTS - Differential Diagnosis
  – Cervical root compression
  – Carpal tunnel syndrome
  – Writer's cramp
  – Medial epicondylitis
  – Elbow joint pathology
• PTS - Results
  – Morris and Peters ’76
    • 5/7 relieved by steroid injection
  – Johnson and Spinner ’79
    • 51 operations (71 pts)
    • All sensory components relieved in 24
    • 4 failures
  – Hartz and Linscheid ’81
    • 36 operations (39 pts)
    • 8 excellent, 20 good

• Summary
  – Median nerve has a predictable pattern of motor and sensory innervation
  – Changes in this pattern are indicative of median nerve pathology
  – Treatment is based on symptoms and level and severity of compression
Stevens et al, Neurology, 2011
The frequency of carpal tunnel syndrome in computer users at a medical facility

- 314 employees surveyed
- 29.6% reported hand paresthesias
- 10.5% met clinical criteria for CTS
- 3.5% confirmed by NCS
- Conclusion: frequency of carpal tunnel syndrome in computer uses is similar to that of the general population

Repetitive Strain Injury

Ireland, Journal of Hand Surgery, 1995

Repetition Strain Injury: The Australian Experience—1992 Update

Damian C. R. Ireland, FRCS, Victoria, Australia
Historical Precedence

- 1713: Ramazzini reported “disease of clerks and scribes” caused by “continuous sitting, repeated use of the hand and strain of the mind.”
- 1833: Sir Charles Bell described “writer’s cramp” with high incidence of “hand spasm.”
- 1882: Robinson described “telegraphist’s cramp” noted similarity to “writer’s cramp.”
  - Incidence increased to 60% of operators after addition in 1908 to schedule of diseases covered by the British Workman’s Compensation Act.
  - After Great Britain and Ireland Post Office Departmental Committee of Inquiry concluded that telegraphist’s cramp was a “nervous breakdown” due to “nervous instability and repeated fatigue,” the incidence subsequently declined.

- 1888
  - “Writer’s cramp”
  - “primarily and essentially nervous system origin, the result of a deranged action in the centres concerned in the act of writing.”
  - “…are of distinctly nervous temperament, irritable, sensitive, bearing overwork and anxiety badly… it is a disease easily imagined by those who have witnessed the disorder.”

Occupational cervicobrachial disorder

- 1960s: OCBD (Japan, Switzerland, Sweden);
  Tension headache and occupational disorder (Finland); occupational complaint number 2101 (German)
  - Occupational cervicobrachial disorder
    - Employees with repetitive stereotyped upper limb exertion and mental stress
    - No preceding trauma
RSI (1980s) CTD (1990s)

- 1980s RSI (Australia)
  - Repetition strain injury
- 1990s CTD (USA)
  - Cumulative trauma disorder

- 1980s, Australia, 34% of Australian workforce afflicted
- RSI-repetitive strain injury
- Clinical presentation
  - Young to middle age
  - Low paying, monotonous, low prestige occupations
  - Deterioration after hand therapy, physiotherapy, and NSAIDs

Australia Historical Context

- Transition period of relative prosperity for Australia
- Inability to work secondary to physical ailment was more socially acceptable than the inability to find work as unemployment started to rise
- Demand for workers decreased as computerization of clerical tasks rose
  - Late 19th century change from feather quill to productive steel nib
Why the meteoric rise of RSI in Australia in 80s

- Rise of medical profession “industrial rehabilitation specialists”—required certification of continuing unfitness for work
- Fear of employer negligence claims “RSI negligence claims”
- Trade union movement—“sufferer’s hand book” dissemination to Public Service (1/3 of Australia total workforce)
- Growth of “paramedical industry”—tactile therapists, consultant mgmnt, ergonomic furniture designers
- Print and electronic media
- Allocation of government resources—entities created that were dependent on the existence of RSI

Demise of RSI

- Australian Medical Journal 1985—emphasized nonphysical origin of RSI, defined as “occupational neurosis”, no localized pathology, no residual permanent disability
- Coordinated and well orchestrated education movement by Australian Hand Surgery Society
- Cooper vs The Commonwealth (1987) —employer not guilty of negligence, the plaintiff had not suffered an injury, awarded all costs against plaintiff

Summary

- Chronic upper extremity overuse can lead to localizable, activity related pain.
- Most cases will resolve with time and non operative management.
- Surgery is successful in the appropriate patient who has failed non operative management.
- For recalcitrant “work related” cases of repetitive stress, a multifactorial approach is warranted addressing individual, psychosocial, and physical factors.
Questions?