CTDs
OT 624 Bio Interventions II
“Believe it or not . . .”

Expert: Carpal tunnel all in workers’ heads

Anatomy Of A Cheez-It®
(But Don’t Believe It!)

- No-Slip Grip
  Helps you grab more Cheez-It® in every handful.

- Air Intake
  Improves aerodynamics during periods of rapid Cheez-It® consumption.

- Surface Dynamics
  Bumpy, crispy, crunchy, utterly satisfying.
Nature of Cumulative Trauma Injury

• Also known as: Cumulative Trauma Disorder (CTD), repetitive motion syndrome (RMS), repetitive stress injury (RSI), overuse syndrome, and WMSD (work-related musculoskeletal disorders – term preferred by NIOSH), and more.

• Consider two major areas as entrapment and musculoskeletal overuse
Nature of Cumulative Trauma Injury

• Common diagnoses include:
  – CTS
  – Cubital tunnel syn
  – Lat. Epicondylitis
  – deQuervains tenosynovitis
  – Pronator syn
  – Rad. N. compression @ supinator
  – Uln. N. comp. @ Guyon’s canal (often with CTS)
  – WFVS (white finger vibration syndrome)

Where are Ryan, Peggy, Cynthia, Rachel in this list?
CTD

Etiology

• Holding and/or moving into/out of extreme or awkward joint positions
• Forceful Exertions
• Repetitions without adequate recovery
• Prolonged cold temps
• Static muscle contractions/holding
• Vibration
• Localized contact stresses
• Combinations: cold, vibration, repetition, force
Also Medical/Anatomical Causes

- Obesity
- Pregnancy
- Lumbrical incursion
- Hypothyroidism
- Diabetes mellitus
- Various/numerous arthropathies
Table 1: Most common peripheral nerve entrapment sites

<table>
<thead>
<tr>
<th>Median nerve</th>
<th>Pronator teres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial nerve</td>
<td>Wrist extensors</td>
</tr>
<tr>
<td>Ulnar nerve</td>
<td>Medial edge of triceps and lig’t of Struthers</td>
</tr>
<tr>
<td>Ulnar nerve</td>
<td>Wrist flexors</td>
</tr>
<tr>
<td>Ulnar nerve (medical chord)</td>
<td>Subscapularis</td>
</tr>
</tbody>
</table>
CTDs: Tissues Involved

- Muscles (in static holding or loading) & musculotendinous junctions
- Tendons & sheaths
- Tendinous attachments to bones
- Peripheral nerves
CTD

• **Symptoms:**
  
  • Paresthesia and numbness in associated nerve distribution (median nerve for CTS - complaint usually “my hand is numb” or “my hand tingles” and not confined to median distribution until more specific sensory evaluation – especially sensory mapping)
  
  • Thenar atrophy (in CTS if long-standing and not addressed; hypothenar atrophy in cub. tun. Syn.);
  
  • Complaints of weakness in hand function
  
  • Decreased AROM; possibly edema
  
  • Impaired dexterity
CTD

Based on Biomechanical, Adaptation, and Environmental Press Approaches - Assessments:

- Sensory - called sensibility in hand evaluation:
  - two-point discrimination (moving and static)
  - stereognosis, Moberg pick-up test
  - Semmes/Weinstein monofilaments (measuring sensory threshold),
  - Vibration (using vibrometer or tuning forks)
  - General mapping

- Grip and pinch strengths - dynamometers
- Volumeter
- Observation in context – Job Site Analysis
CTD

- Finkelstein’s test for deQuervain’s
- Elbow flexion (for cubital tunnel)
CTS

• Assessments (continued)
  • Observation in context – Job Site Analysis
  • Tinel's percussion test, Phalen's wrist flexion test (provocative tests for CTS)
  • Nerve conduction velocity (NCV) and electromyograph (EMG) - both are referred to as electrodiagnostics and performed by MD for entrapment
For an important perspective on how complicated CTD can be, see:

Archives of Internal Medicine, July 27, 1998
v158 n14 p1506(7)

or click on:

Recurrent Medical Disease in Work-related Carpal Tunnel Syndrome

by Steven G. Atcheson; John R. Ward; Wing Lowe

YOU MUST at least read the abstract of this article as found in the link.
• One hundred nine separate atraumatic illnesses (mainly hypothyroidism, diabetes mellitus, and various arthropathies) capable of causing arm pain or CTS were diagnosed in a third of all (297) patients.

• Using record reviews and patient histories alone, 68% of these conditions would have been missed. One hundred ninety-eight patients had been diagnosed as having CTS 420 times in more than 1000 office visits.

• Every case definition of CTS was significantly associated with a related medical condition.
• Conclusions: Routine patient histories and record reviews are inadequate for proper evaluation of work-related CTS. Unrecognized medical diseases capable of causing CTS are common. Studies asserting an association between occupational hand usage and CTS are of questionable validity unless they prospectively account for confounding disease and obesity. Arch Intern Med. 1998; 158: 1506-1512
The Cumulative Injury Cycle

1. Acute Injury
2. Repetitive Injury
3. Constant Pressure or Tension

- Weak and Tense
- Adhesion-Fibrosis
- Inflammation
- Tear or Crush
- Friction, Pressure, and Tension
- Decreased Circulation, Edema

Inflammation Cycle
Chronic Cycle
Intervention: Perspective

Model of Repetitive Motion

I = Insult to the tissues
N = Number of repetitions
F = Force or tension of each repetition as a percent of maximum muscle strength
A = Amplitude of each repetition
R = Relaxation time between repetitions (lack of pressure or tension on the tissue involved)

I ≈ \frac{NF}{AR}
Intervention: OT Perspective (Narrow View??)

• Therapeutic Maintenance:
  – Temporary immobilization/rest
  – Pain management
  – Scar massage
  – Desensitization
  – Work hardening
Intervention: OT Perspective (Narrow View??)

• Ergonomic Equipment/adaptations:
  – Gloves
  – Wrist supports
  – Adapted tools/work stations/Software

• Body Mechanics:
  – Avoid extreme/awkward postures
  – Lifting/handling instructions (Mr. B case study?)
Intervention: OT Perspective (Narrow View??)

- Work Simplifications (mostly administrative controls):
  - Rest periods – when/how long
  - Stretching/wram-up
  - Efficient working
  - Rotate job tasks – mix it up
Elements of Intervention (NIOSH – WIDER view)

The seven elements of an effective program comprise a seven-step "pathway" for evaluating and addressing musculoskeletal concerns in an individual workplace. Each step is addressed in more detail in the primer, with examples drawn from actual NIOSH workplace evaluations. The seven steps are as follows:
• One: *Looking for signs of a potential musculoskeletal problem in the workplace*, such as frequent worker reports of aches and pains, or job tasks that require repetitive, forceful exertions. ([http://www.cdc.gov/niosh/docs/97-117/epstep1.html](http://www.cdc.gov/niosh/docs/97-117/epstep1.html) - then follow along to the subsequent steps at the bottom of this webpage); see Table 1a and Toolbox tray 1.a

• Two: *Showing management commitment in addressing possible problems* and encouraging worker involvement in problem-solving activities. ([http://www.cdc.gov/niosh/docs/97-117/epstep2.html](http://www.cdc.gov/niosh/docs/97-117/epstep2.html)) – see tray 2.a – literature!
• Three: **Offering training to expand management and worker ability** - building **in-house expertise** to evaluate potential musculoskeletal problems.  
(http://www.cdc.gov/niosh/docs/97-117/epstep3.html)

• Four: **Gathering data to identify jobs or work conditions that are most problematic**, using sources such as injury and illness logs, medical records, and job analyses. See link to Exhibit 10 (http://www.cdc.gov/niosh/docs/97-117/epstep4.html)
• Five: *Identifying effective controls for tasks that pose a risk* of musculoskeletal injury and evaluating these approaches once they have been instituted to see if they have reduced or eliminated the problem. ([http://www.cdc.gov/niosh/docs/97-117/epstep5.html](http://www.cdc.gov/niosh/docs/97-117/epstep5.html))

• Six: *Establishing health care management* to emphasize the importance of early detection and treatment of musculoskeletal disorders for preventing impairment and disability. ([http://www.cdc.gov/niosh/docs/97-117/epstep6.html](http://www.cdc.gov/niosh/docs/97-117/epstep6.html))
Seven: *Proactive Ergonomics - Minimizing risk factors* for musculoskeletal disorders when planning new work processes and operations; it is less costly to build good design into the workplace than to redesign or retrofit later. (http://www.cdc.gov/niosh/docs/97-117/epstep7.html)
New slide – What is this problem?
Reasons for Poor Follow-through:

• Long-standing poor work habits
• Recommendations in conflict with job requirements
• Low or no employer support
• Therapist’s goals at odds with client’s goals
Reasons for Failure to Report

• Strong work ethic & peer pressure (more work for others and accused of “faking”)
• Fast-paced incentives
• Fear of losing job, personal finances
• Language barriers
• Being naïve to seriousness of symptoms
Also: “Double Crush” Phenomenon

- symptoms don't follow discrete peripheral innervation patterns
- electrodiagnostic tests are often negative
- individuals often are passed off as hysterical. (i.e., Complaint is "My whole hand feels numb sometimes" – because we are looking for complaints that can be interpreted as median, ulnar OR radial n. problems
Double Crush (continued)

- neck hyperextended, chin protruding
- thoracic and lumbar kyphosis
- shoulders protracted/rounded
- arms unsupported, elbows flexed over 90 degrees to reach a too high keyboard
- forearms pronated (constantly), wrist hyperextended
- lots of repetitive finger flexion from hammering on the keyboard
Double Crush (continued)

- overworked and shortened upper trap and levator scapulae
- underused and shortened pec major and minor and serratus
- constantly stretched ulnar nerve
- overworked and shortened pronator (more likely to pinch median n. @ pronator if forearm supinated)
- stretched radial nerve at the supinator
- overworked and shortened wrist extensors
- stretched median and ulnar nerves at the wrist
Evidence????
Randomized controlled trials (RCTs) from January 1985 to May 2006

Thirty-three RCTs were included in the review

- Locally injected steroids produce a significant but temporary improvement,
- Vitamin B6 is ineffective,
- Steroids are better than non-steroidal anti-inflammatory drugs (NSAIDs) and diuretics
- Ultrasound is effective while laser therapy shows variable results,
- Exercise therapy is not effective,
- Splints are effective, especially if used full-time.

_A systematic review of conservative treatment of carpal tunnel syndrome_
Conclusions:

1. strong evidence (level 1) on efficacy of local and oral steroids;
2. moderate evidence (level 2) that vitamin B6 is ineffective and splints are effective and
3. limited or conflicting evidence (level 3) that NSAIDs, diuretics, yoga, laser and ultrasound are effective whereas exercise therapy and botulinum toxin B injection are ineffective

A systematic review of conservative treatment of carpal tunnel syndrome
Clinical Rehabilitation. 2007. Volume 21; Issue 4; Pages 299-314
• Total of 34 English language articles that presented original data were included in this review
• **Endoscopic release was associated with higher levels of physical functioning and fewer days to return to work when compared to open release.**
• **Limited evidence indicated:**
  • *steroid injections and oral use of B6 were associated with pain reduction;*
  • *in comparison to splinting, range of motion exercises appeared to be associated with less pain and fewer days to return to work;*
  • *cognitive behavior therapy yielded reductions in pain, anxiety, and depression;*
  • *multidisciplinary occupational rehabilitation was associated with a higher percentage of chronic cases returning to work than usual care.*
• **Workers’ compensation status was associated with increased time to return to work following surgery.**

**Clinical Management of Carpal Tunnel Syndrome: A 12-Year Review of Outcomes**
<table>
<thead>
<tr>
<th>Outcome category</th>
<th>Measure(s)</th>
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<tbody>
<tr>
<td>Medical status</td>
<td>Two-point discrimination</td>
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<tr>
<td></td>
<td>Nerve conduction velocity</td>
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<tr>
<td></td>
<td>Sensory</td>
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<td></td>
<td>Motor</td>
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<td>Semmes-Weinstein</td>
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<td>Phalen’s test</td>
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<td></td>
<td>Tinel’s test</td>
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<td></td>
<td>Thenar atrophy</td>
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<td></td>
<td>Interstitial pressure</td>
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<tr>
<td>Symptoms (self-report)</td>
<td>Pain</td>
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<td>Tenderness</td>
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<td></td>
<td>Numbness</td>
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<td>Parasthesia</td>
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<td></td>
<td>Weakness</td>
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<td></td>
<td>Night symptoms</td>
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<tr>
<td></td>
<td>Fine dexterity loss</td>
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<tr>
<td>Function</td>
<td>Grip</td>
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<td></td>
<td>Key pinch</td>
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<td></td>
<td>Pulp pinch</td>
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<tr>
<td></td>
<td>Range of motion</td>
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<tr>
<td></td>
<td>Activities of daily living</td>
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<tr>
<td>Work Status</td>
<td>Median days out of work</td>
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<tr>
<td></td>
<td>Workers’ compensation status</td>
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<td></td>
<td>Working with pain</td>
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<tr>
<td>Psychological well-being</td>
<td>Anxiety</td>
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<td></td>
<td>Depression</td>
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<td></td>
<td>Coping strategies</td>
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<td></td>
<td>Sickness</td>
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<tr>
<td>Patient satisfaction</td>
<td>Treatment satisfaction rating</td>
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</tbody>
</table>
• Very little scientific support for the range of options currently used in practice.

• Despite the emerging evidence of the multivariate nature of CTS, the majority of outcome studies have focused on single interventions directed at individual etiological factors or symptoms and functional limitations secondary to CTS.
• The success rates (based on general improvement) after 3 months were 80% for the surgery group (62/78 patients) vs 54% for the splinting group (46/86 patients), which is a sig. difference (P = 0.001).

• After 18 months, the success rates increased to 90% for the surgery group vs 75% for the splinting group, which is sig. difference (P=.02). (Also, by that time 71% of the splint group had also received the surgery treatment.)
CONCLUSIONS: There is limited evidence for the effectiveness of keyboards with an alternative force-displacement of the keys or an alternative geometry, and limited evidence for the effectiveness of exercises compared to massage, breaks during computer work compared to no breaks; massage as an add-on treatment to manual therapy, and manual therapy as an add-on treatment to exercises.