Introduction

Learning Objectives

- Participants will:
  - understand risk factors of carpal tunnel syndrome (CTS).
  - critique effectiveness of nonsurgical CTS interventions as reported by current research.
  - create list of evidence-based interventions for use in current practice improve CTS therapy outcomes.
  - recognize how nerve and tendon gliding exercises create change in symptoms of CTS.

Evidence-based Nonsurgical Approach to Carpal Tunnel Syndrome Intervention

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The Carpal Canal: Review of Anatomy

- Flexor pollicis longus
- Flexor digitorum superficialis
- Flexor digitorum profundus


Carpal Tunnel Syndrome (CTS)

- Impingement of median nerve
- Symptoms
  - Numbness/tingling
  - Clumsiness
  - Sx worse with grip
  - Thenar atrophy


Risk Factors

Environmental:
- Vibration
- Cold
- Repetition of grip and posture
- Sustained wrist flexion/extension
- Sustained grasp/pinch
- Impact to volar wrist

Other factors:
- Diabetes, other endocrine disorders
- Obesity
- Acute trauma
- Pregnancy
- Systemic diseases

(Kostopoulos, D., 2004)

Retrieved from http://www.formortho.com/images/photos/top_carpal.gif
Demographics

- Women 5.3%
- Men 2.1%
- 1-3% of population

Financial Implications

- 400,000 surgical procedures in US/yr.
- $2 Billion dollars spent in medical costs
- Loss of workdays
- Worker's comp UE musculoskeletal disorders

(Hashstede et al., 2010, Muller et al., 2004)

Intervention Options

Surgical
- Endoscopic decompression
- Open decompression

Nonsurgical
- Corticosteroid injections
- Oral steroids
- Ultrasound
- Orthotic use
- Nerve and tendon gliding
- Carpal bone mobilization
- Yoga
- Low light laser therapy
- Ergonomic considerations

Literature Review Findings
Use of Orthotics

- Immobilization effective
- Custom orthotics > OTC
- Full-time use > nocturnal splinting in some studies
- Effective for pregnant women

(Muller et al., 2004)

Orthotic Type?

- Custom vs. non-custom splints
  - Fabricated neutral wrist with MCP orthotic may be more effective than the OTC splint.
  - Reduces symptoms
  - Improves function
  - short term

(Brininger et al., 2007)

Table 1. Pressure Within the Carpal Tunnel in Normal and Carpal Tunnel Syndrome Patients

<table>
<thead>
<tr>
<th>Position</th>
<th>Control Group</th>
<th>Carpal Tunnel Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range (mmHg)</td>
<td>Average ± SD (mmHg)</td>
</tr>
<tr>
<td></td>
<td>Range (mmHg)</td>
<td>Range (mmHg) Average ± SD (mmHg)</td>
</tr>
<tr>
<td>Raising</td>
<td>10–48</td>
<td>234 ± 5.74</td>
</tr>
<tr>
<td>Flexion</td>
<td>273–281</td>
<td>234 ± 9.80</td>
</tr>
<tr>
<td>Extension</td>
<td>192–137</td>
<td>396 ± 19.4</td>
</tr>
<tr>
<td>Wrist Extension</td>
<td>100 ± 51.3</td>
<td>101 ± 5.61</td>
</tr>
<tr>
<td>Isolated Phalanges</td>
<td>70 ± 58.2</td>
<td>70 ± 6.32</td>
</tr>
<tr>
<td>Hold</td>
<td>50 ± 58.2</td>
<td>70 ± 6.32</td>
</tr>
<tr>
<td>After Exercise</td>
<td>9.0 ± 9.38</td>
<td>14 ± 19.34</td>
</tr>
<tr>
<td>Forearm Compartment</td>
<td>1–9</td>
<td>4.3 ± 2.1</td>
</tr>
</tbody>
</table>

(Seradge, Hu, & Douce, 1995)
Wrist position and duration

- 0° wrist extension improvements
- > 20° extension
- Full-time (FT) wear > day wear
- Night orthotic > injection
- Neutral position night wear > ergonomic instructions group
- Orthotic + NSAIDs = cortisone injection
  (Piazzini et al., 2007)
- Night wear > no tx
  (Huisstede et al., 2010)

Manual Therapy

- Carpal mobilization and stretch of the flexor retinaculum reduces pain over no tx.
- Also found to increase AROM (wrist extension).
  (Muller et al., 2004)

Use of Ultrasound

- Conflicting results
- Use of 1 MHz pulsed supported
- Use of continuous 3 MHz US not supported
  (Muller et al., 2004)
- Significant improvements:
  - use of low intensity US > NSAID’s and sham US
  - US > low level laser
  (Piazzini et al., 2007)
Corticosteroid Injections
- Clinical improvement > placebo @ 1 mo.
- Injection > oral steroids up to three months post (Kostopoulos, 2004, Marshall et al., 2002)
- Strong evidence > placebo
- Steroid vs. lidocaine patch
  - both improved after 4 wks.
- Steroid injections > steroid iontophoresis
  - Both improved (Piazzini et al., 2007)

Oral Medication
- Prednisone (20 mg/day for 2 weeks, then 10 mg/day for 2 wks) > improvement over diuretics, NSAID’s, and placebo (Piazzini et al., 2007)
- Oral steroids > splinting at 2 weeks
  - no significant differences noted at 3 months. (Huisstede et al., 2010)

Magnetic Therapy
- Study #1 No pain reduction with wrist magnets vs. sham treatment
- Study #2 Paresthesia reduction with lower strength magnetic therapy > sham tx
  - May have been as a result of the immobilization factor (Muller et al., 2004)
Yoga

- Symptom reduction
  - Biweekly 60-90 minutes hatha yoga for 8 weeks > splinting
  - Did not improve grip strength or reduce pain over splinting (Muller et al., 2004)

- Pain reduction
  - Yoga vs. wrist splinting—no significant difference at 8 weeks (Huisstede et al., 2010)

Acupuncture

- Inconclusive evidence to support:
  - Reduction in pain
  - Sx of CTS
  - Improvement in grip strength (Muller et al., 2004)

- No improvement with use of laser acupuncture or acupuncture compared to oral steroid drugs (Huisstede et al., 2010)

Low Level Laser

- Limited support for low level laser therapy (Muller et al., 2004)

- No improvement between low power laser and sham laser

- Decreased sensory latency with low level laser and TENS vs. sham and TENS (Piazzini et al., 2007)

- No evidence to support low level laser with splinting over splinting only (Huisstede et al., 2010)
Other interventions not supported by literature

- Vitamin B6
- Dexamethasone iontophoresis vs. placebo distilled H2O iontophoresis @ 3 months and 6 months
- Manual therapy, myofascial massage, US, night splinting DOES NOT improve nerve conduction, physical and mental distress, or sensation more than night splinting alone.

(Huisstede et al., 2010)

Nerve and Tendon Gliding Exercises

- 28 patients with CTS
- Randomly assigned
  - Splint
  - Splint + nerve and tendon gliding exercise
- Significant improvement in all outcomes in both groups
- Difference between groups not significant

(Akalin et al., 2002)

Efficacy of tendon and nerve gliding exercises for carpal tunnel syndrome: A systematic review of randomized controlled trials

- 4 RCTs
  - "Symptom severity decreased and functional status improved with combined treatment, involving a tendon or nerve gliding exercise group plus conventional treatments, compared with the use of conventional treatments alone"

(Kim, 2015)
The Comparative Effectiveness of Tendon and Nerve Gliding Exercises in Patients with Carpal Tunnel Syndrome

- 53 patients with CTS
- Randomly assigned
  - 1. Splint + paraffin + tendon gliding
  - 2. Splint + paraffin + nerve gliding
  - 3. Splint + paraffin
- All groups improved pain
- Group 1: significant improvements in functional status, DASH, and physical aspect of quality of life

(Horng, Hsieh, Tsai, Horng, & Wang, 2011)

Impressions of Tendon and Nerve Gliding

- Mixed results
- Limited high level evidence to support nerve and tendon gliding exercises
- May be more effective in combination with other conservative treatments
- Serve as a cheaper, non-invasive method

Summary

*How effective is tendon and nerve gliding as a conservative treatment for relieving symptoms of carpal tunnel syndrome?*

- High level evidence lacking
- Long term satisfaction unknown
- Economical first option
What does the literature say about surgery?

May be indicated when:
- Conservative tx fails
- When ax's have become severe
- When thenar atrophy exists

Found to be more effective than splinting midterm and long term
Found to be more effective than NSAIDs and hand therapy
No evidence for effectiveness of endoscopic vs. open decompression

(Heusden et al., 2010)

Overall Clinical Impressions

• POSSIBLE EFFECTIVE APPROACHES
  - FT splinting > part time; custom orthotics > OTC
  - US 1MHz at .5 wcm2 for 10 min. 5x/wk for 4 wks
  - Corticosteroid injections > steroids; short term benefit
  - Nerve and tendon gliding when combined with conventional tx
  - Carpal mobilization may reduce pain and increase AROM

Synthesis of Information

• What is your “take-away?”
  - Make a note of one or two ways you will change your approach to increase your effectiveness with patients with CTS
HOW DO TENDON AND NERVE GLIDING EXERCISES RELIEVE SX'S OF CTS?

Mechanisms of change

About Tendon & Nerve Gliding
• Procedures
  • 5 sec hold, 10 reps, 5x/day
  (Akalin et al., 2002)
  • 7 sec hold, 5 reps, 3x/day
  (Horng et al., 2014)
Exclusion Guidelines for Conservative Treatment

- > 50 years of age
- Duration greater than 10 months
- Constant paresthesia
- Stenosing flexor tenosynovitis
- Positive Phalen's test result in < 30 seconds
- Thenar atrophy

Retrieved from https://s-media-cache-ak0.pinimg.com/236x/3b/e3/aa/3be3aac9b0cc2196aea82fc51360be28.jpg
(Aklin et al., 2002)

Tendon Gliding

- Maximize excursion of flexor tendons relative to one another
- Prevent formation of adhesions
- Improve synovial fluid lubrication in the carpal tunnel bursae
- Reduces tenosynovial edema

Retrieved from https://www.youtube.com/watch?v=U6i1thssxbyw
(Aklin et al., 2002; Hong et al., 2011; Skirven, 2011)

Nerve Gliding

- Decrease viscosity of axoplasm
- Improves axonal transport
- Increased intra-neural blood flow
- “Milking” action
- Maximize longitudinal excursion

Retrieved from https://www.youtube.com/watch?v=6teVc6Tu2Cw
Retrieved from http://www5.aaos.org/icm/icm/icm002/figures/icm002_f05_L.jpg
(Shacklock, 1995; Aklin, 2002)
What About Nerve Tensioning?

- Elongate the nerve bed
- Increase nerve tension
- Increase intraneural pressure

Nerve Gliding vs. Tensioning

Gliding vs. Tensioning

Different nerve gliding exercises induce different magnitudes of nerve movement. An in vivo study using dynamic ultrasound imaging by Michel Coppiters, Alan Hough, and Andrew Dilley from The University of Queensland, Australia.
Splinting options

Questions?

Thank you for coming!

References


