SONOGRAPHIC NEEDLE GUIDANCE FOR CARPAL TUNNEL SYNDROME & MORTON’S NEUROMA – IMT CYST COMPLEX

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No Conflicts of Interest
SONOGRAPHIC NEEDLE GUIDANCE FOR CARPAL TUNNEL SYNDROME

OBJECTIVES

1. Explain Sonoanatomy of CT, Morton’s and adjacent structures
2. Discuss approaches for sonographic needle imaging
3. Distinguish structural abnormalities and anatomic variants that will affect procedure
4. Illustrate the technique(s) of US injections
The carpal tunnel has two levels of examination:

- **PROXIMAL**: scaphoid tubercle ▲ pisiform
- **DISTAL**: trapezium tubercle ▲ hamate hook
Carpal Tunnel Syndrome

- **Shoulder Sign**
- **Focal Entrapment**
- **Hypervascularity**

X-Sectional Diameter inside Epineurium >10MM²
What’s The Evidence That Carpal Tunnel Injections Are Beneficial Mild to Moderate CTS?
What’s The Evidence That Carpal Tunnel Injections Are Beneficial?

Are steroid injections into the CT beneficial?
Overall 80% benefit lasting 1 year (Bland J. 2018.)

Is it any better than night splints?
Yes, in the short term (6wk), when compared to anatomic guided injection of 20 mg depo. (INSTINCT Trial, Lancet 2018).

Is ultrasound guidance required to achieve a long term benefit?
55% reduced need for retreatment within 1 year if steroid injection performed by US Guidance (Evers, S. Arthritis Care & Research 2017.)

Do we need to inject steroids into the CT or will any volume expander work?
Wu Y-S, et al used 5 ml saline with US guidance hydrodissection compared to 5 ml sc (sham) injection, with 6 month follow up. (Muscle & Nerve Feb 2019).

If you choose to inject the CT with steroids, what technique is recommended?
Effectiveness of Ultrasound-Guided Carpal Tunnel Injection Using In-Plane Ulnar Approach

A Prospective, Randomized, Single-Blinded Study


3 month follow up

Injectate 40 mg. Kenalog + 1 ml. Xylocaine (2 ml. total)

Small sample size - 15 hands per group.

Measures used: symptom severity scale, US and NCS.
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RELEVANT SONOANATOMY
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Approaches for Sonographic Needle Imaging

PROBE SELECTION: High Frequency Linear Transducer with Short Footprint

IN-PLANE

OBLIQUE STANDOFF
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Approaches for Sonographic Needle Imaging

SHORT AXIS

LONG AXIS
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Approaches for Sonographic Needle Imaging

OUT OF PLANE - SHORT AXIS
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Medial vs Radial Approach

Palmar Cutaneous Branch of Median Nerve by Martinoli
Recurrent Motor Branch of the Median Nerve innervates:
Opponens Pollicis
Abductor Pollicis Brevis
Flexor Pollicis Brevis (superficial head)

Electrocution Hand Injury with Carpal Tunnel Symptoms
1 year later
Sent for Carpal Tunnel Injection
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US vs Anatomic Guidance
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Indications for Carpal Tunnel Injection

1. Mild to Moderate median n. delay at the wrist on NCS.

2. Failure to respond to conservative management

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Indications for Carpal Tunnel Injection

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2. Failure to respond to conservative management

3. Secondary to treatable underlying disorder
PRE-ASSESSMENT
DYNAMIC IMAGING of MEDIAN NERVE
PRE-ASSESSMENT
DYNAMIC IMAGING of MEDIAN NERVE
Strategies to Avoid Nerve Injury

- Patient position- seated with wrist supinated and slightly dorsiflexed, use rolled towel.
- Transducer must be perpendicular to the nerve
- Identify the outer epineurium
- Optimize the focal zone and gain
- Set depth so that target takes up the majority of the screen
- Use highest frequency of probe
- Position the patient to be inline with screen to allow easy manipulation of the needle while observing the screen.
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PROCEDURE PREPARATION

1. Informed consent
2. Patient position: Seated or supine position with supinated wrist
3. Preliminary US evaluation of the nerve should be performed before the injection to identify anatomical landmarks, focal abnormalities, location of the nerve and plot needle trajectory. Adjacent vascular structures (ulnar and radial arteries, persistent median artery) should be noted and avoided during injection.
4. Standard sterile technique is used. Skin should be cleaned using alcohol-based or equivalent skin sanitizer (chlorhexidine). The US transducer should be cleaned and prepared following manufacturer’s instructions.
5. Mixture of corticosteroid and anesthetic is prepared. Typical injectate consists of 1 ml of 40 mg/ml methylprednisolone acetate and 1 ml of 1% lidocaine, plus saline using ultra fine #27 needle.
SUPPLIES
After obtaining skin anesthesia (vapocoolant spray) the needle is passed into the skin on the ulnar side (or less commonly radial side depending on pre-procedure scanning) at the level of proximal carpal tunnel in transverse view. The needle is passed superficial to ulnar artery and nerve, penetrating the TCL. The needle trajectory should be as close to perpendicular to the transducer beam as possible to maximize visualization of the needle (in-plane approach). Using US guidance, the operator should slowly advance the needle towards ulnar side of the median nerve with tip directly adjacent to the epineurium (echogenic rim) without advancing the needle through the nerve. Solution is injected superficial to median nerve. Flow of the injectant is visible under US, should be located around the nerve. While injection is being performed no resistance should be felt, the patient should not be experiencing pain. The nerve is typically is being “peeled off" the undersurface of TCL. The needle then slightly withdrawn and redirected deeper from the median nerve and again solution is injected. US guidance allows visualization of solution spread, and needle positioning can be adjusted to allow circumferential spread of injectate completely surrounding the nerve and separating it from surrounding tissues. The typical volume of injectant is 2 ml (range from 2 to 4 ml). After completion of the injection needle is removed, local compression applied. At least one image of needle positioning under sonographic guidance should be recorded and saved for documentation.
MEDIAN NERVE PERINEURAL INJECTION
Carpal Tunnel Syndrome

- **Hydro dissection**
  - Large volume of liquid to mechanically separate the nerve from potentially compressing/adherent surrounding tissue
  - Ulnar US-G approach *(SMITH 2010)*

Ultrasound Guided Hydrodissection-cadaver model

Muscle & Nerve Jan. 2018
REFERENCES


Inflammatory and Neuralgic Foot Lesions

PATIENT GLOBAL PAIN INDEX
Before & After
MORTON’S NEUROMA
Plantar Interdigital Neuroma
ANATOMY

2 compartments

Dorsal Transverse Intermetatarsal Ligament

DORSAL

DORSAL

M

M

INTERMETATARSAL BURSA

DEEP INTERMETATARSAL LIGAMENT

NEUROVASCULAR BUNDLE

PLANTAR PLATE

FLEXOR DIGITORUM LONGUS

FLEXOR HALLUCIS BREVIS

METATARSAL PHALAGEAL JOINT

Courtesy of Carlo Martinoli

Courtesy of David Bong
85% of surgically proven neuromas were detected by pre-operative US.

Hypoechoic (80%)
Size: often 5-10mm to be symptomatic

separating the metatarsal heads to improve visualization
Morton Neuroma

How To Scan

DYNAMIC FOREFOOT SCANNING
SONOGRAPHIC MULDER’S SIGN
Torriani & Kattapuram AJR 2013
MORTON’S NEUROMA – US-GUIDED INJECTION(S) preferred technique

Patient Position
Prone (toes up)

Transducer Position
Short Axis over MT Heads

Needle Position
Out of Plane, Distal to Proximal
Then in-plane as transducer is turned long axis

What to inject and how often?

Option 2

Option 3
Morton Neuroma
Perineural Injection of Steroid

Types of Injections
1. Diagnostic
2. Therapeutic
3. Neurolytic

INTERMETATARSAL CYST
## Steroid Properties

<table>
<thead>
<tr>
<th>Agent</th>
<th>Relative Anti-inflammatory Potency</th>
<th>Relative Mineralocorticoid Potency</th>
<th>Solubility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrocortisone</td>
<td>1</td>
<td>2-3</td>
<td>High</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>4</td>
<td>1</td>
<td>Medium</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>5</td>
<td>0</td>
<td>Medium</td>
</tr>
<tr>
<td>Triamcinolone</td>
<td>5</td>
<td>0</td>
<td>Medium</td>
</tr>
<tr>
<td>Betamethasone</td>
<td>20-30</td>
<td>0</td>
<td>Low</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>20-30</td>
<td>0</td>
<td>Low</td>
</tr>
</tbody>
</table>

- Methylprednisolone (Depo-Medrol) and triamcinolone acetonide (Kenalog) cause less local postinjection flares than longer-acting agents.
- Triamcinolone acetonide (Kenalog) and triamcinolone hexacetonide (Aristospan) are less soluble and therefore longer acting.
- Less soft-tissue atrophy and risk of tendon rupture is seen with dilution of the steroid by lidocaine.