Carpal Tunnel Syndrome

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Intentions

- **The purpose of this discussion is to open the issue of work related carpal tunnel syndrome**
- **Though particular positions may be vigorously defended, the spirit of philosophical examination demands that no stance be assumed dogmatically and that all positions be open to further examination and thought**

History

- 1854, Sir James Paget reported that chronic median nerve compression could occur following a fracture of the distal radius
- "*developed ulceration of* the *thumb and fore and middle fingers, which resisted various treatments, and was cured only by binding the wrist that, the parts on the palmar aspect being relaxed that pressure on the nerve was removed...*

- l880 James J. Putnam, a Boston neurologist, Archives of Medicine (New York) 4: 147-162
- *"While differing from each other in minor respects, these cases agree in presenting as a common symptom a disturbance of the subjective sensibility of the skin, giving rise to what is known popularly as numbness, recurring periodically, coming on especially at night or very early in the morning, and affecting one or both hands…*

- *..This numbness was very often excessively intense, so as to amount to real pain in itself…In some of the cases simply letting the arm hang out of the bed or shaking it about form some moments would drive the numbness away;*
- *in others, this could only be done by prolonged rubbing and use of the hands in ordinary employment."* The majority of patients were women, with an average age of 35 years

- Putman referred to earlier observations of Raynaud and Vulpian and concluded that
- sensory changes in the median nerve distribution were caused by "*alterations of the blood supply to the smaller branches or terminal filaments of the sensitive nerves supplying the affected districts."*

- Treatment consisted of:
  - galvanism
  - phosphorus
  - amyl nitrite
  - potassium bromide
  - cannabis indica

- 1893, Franz Schultz introduced the term Urber Akroparaesthesie
- sensory symptoms in the median nerve distribution without motor findings
- most of the patients were women with nocturnal pain and paraesthesias.

1909, James Ramsey

- Occupation Neuritis of the Thenar Branch of the Median Nerve: a well defined type of atrophy of the hand.
- Atrophy a specific and independent disease process.
- Nerve compression resulted from occupational over use
- Electrical stimulation and change of jobs

1911: Hunt

- He added the observation that "*at times the fingers felt numb and would tingle,"* **but** did not connect the sensory symptoms with the motor deficit, because he believed "*the sensory changes more in the nature of an acroparesthesia."*

1913,Pierre Marie and Charles Foix

Autopsy finding in an 80 year women with bilateral thenar atrophy. *"The median nerve starting in the distal fourth of the forearm shows a slow increase in volume. Immediately proximal to the annular ligament a nodular thickening is present, which looks and feels like a neuroma. Underlying the annular ligament, however, the nerve suddenly becomes thin"*

- Microscopic examination of the nodular thickening - *'An enormous increase in the connective tissue (that is) interfascicular as well as intrafascicular. The myelin sheaths are progressively diminished from the beginning of the nodular thickening, and at the constriction they are nearly completely absent."*

- Based on this observation they stated, "*Perhaps in a case in which the diagnosis is made early enough, transaction of the ligament could stop the development of these phenomena.*"

Learmonth, J.R. (1933)

- Reported on release of the transverse carpal ligament for post traumatic median nerve compression
- His surgical technique, *"The median nerve was exposed at the wrist. It was compressed between the anterior annular ligament and the arthritic outgrowths from the carpal bones. Scissors were passed under the skin so that one blade was superficial and the other deep to the annular ligament, which was then divided completely. The skin edges were approximated by sutures."*

1938, F.P. Moersch

- Described a syndrome of spontaneous median nerve compression, which would appear in the later decades of life
- Which in *some instances paresthesias and even sensory changes would occur with thenar atrophy."*

"It is important to recognize this syndrome, incorrect diagnoses of progressive muscular atrophy, tumor of the cervical portion of the spinal cord, cervical rib, or neuritis of the brachial plexus and so forth, often is made, indicating a grave prognosis

1945, R.B. Zachary

- He noted that an emerging consensus of a “syndrome” exists which could explain previous reports of coexistent thenar atrophy and sensory changes.

“In patients presenting with the syndrome there are good grounds for suspecting a lesion of the main trunk of the median nerve and possibility of compression of the nerve in the carpal tunnel”

1946, B.W. Cannon and J.G. Love

- First carpal tunnel release for **spontaneous *median* nerve** compression in the carpal tunnel
- nine patients, three of which had spontaneous development of carpal tunnel syndrome.

- Pain was consistently relieved
- *“the improvement of the neurological status varied inversely to the degree of the impairment of nerve function”*

1947. W.R. Brain *et al.*

- Described spontaneous median nerve compression at the level of the carpal tunnel.
- The syndrome occurring
  - in the absence of trauma
  - must not be and it should not be confused costoclavicular syndrome

"*clinical picture that begins with burning and tingling sensations in the distribution of the median nerve in the hand. Numbness and thenar muscle weakness may develop and these muscles waste fairly rapidly. can only be caused by a median nerve lesion and not a lesion involving the brachial plexus.*"

- Spontaneous recovery did not occur
- Recommended early operative release of the transverse carpal ligament.
- Postulated ischemia of the nerve as the cause of the condition

- 1950, George Phalen "*J.A.M.A. 145: 15: 1129-1132 "Spontaneous Compression of the Medial Nerve at the Wrist*"
- He stated that pain and numbness in the fingers are relatively common complaints. These symptoms are usually of secondary importance and hardly worthy of the physician's serious consideration

- There are many patients, however, who come to the physician specifically for relief from pain and numbness in their hands, who have no other complaints whatsoever
- He reported 11 cases, 8 of which had been previously reported.

History - Phalen

- Diagnosis of spontaneous compression of the median nerve at the wrist is relatively simple.
  - History of gradual numbness and tingling in the median distribution

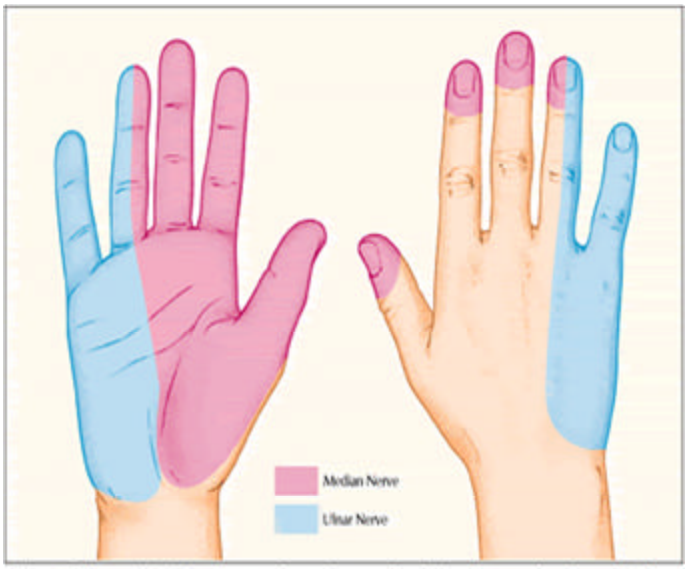

Figure 2. In most patients with carpal tunnel syndrome, pain and paresthesias are limited to the area supplied by the median nerve. Some patients also have signs of ulnar nerve compression, but widespread involvement of the hand suggests the presence of a metabolic derangement or inflammatory process (e.g., rheumatoid arthritis).

- In most cases the patients complained of progressive weakness and clumsiness in their hands
- In every case active use of the hands aggravated the symptoms.
- *The numbness and paresthesias in the fingers of theses patients could be increased by sharply flexing the wrist for a period of 60 seconds.*
- *Prompt improvement in the symptoms would result with release of the wrist from the flexed position*

- *The two most reliable and most constant diagnostic observations were*
  - *Tinel's sign over the median nerve at the wrist*
  - *strictly limitation of all sensory findings to the median distribution distal to the transverse carpal ligament*

- In the 1950's it was widely believed that compression, either by a cervical rib or subclavian aneurysm could produce motor and sensory changes in the median nerve distribution in the hand

Clinical Diagnosis

- Carpal Tunnel Syndrome is a constellation of symptoms
  - Numbness in the hand in the area supplied by the median nerve, with sparing of the dorsum of the hand and little finger.
  - Awakening at night with paraesthesias or numbness in the hand
  - Relieved by flicking the hand or shaking the hand
  - In severe or late cases, thenar atrophy of the muscles supplied by the median nerve. this occurs in less than 15% of patients

Clinical Examination – Tinel's Sign

- Tinel's sign - Literature only minimally useful in identifying carpal tunnel as a stand alone test
- Jules Tinel (1879-1952) was a French neurologist born into a family of 5 generations of physicians/ His teachers were some of the greatest names in French medicine at the beginning of the 20th century. Tinel obtained his doctorate in 1910 and during World War 1 served as the head of the neurological center in Le Mans, France.

- After the war, Tinel worked on psychosomatic aspects of medicine. He was also actively involve in the French resistance and was imprisoned. His son, Jacques was killed by the Nazis. In 1945, he worked at Boucicaut Hospital in Paris, France. He died of heart failure in 1952.
- Tinel described 2 clinical signs, both of which involved the tapping on a peripheral nerve trunk that has been damaged and noting tingling sensation as a sign of regeneration.

Clinical Diagnosis

- Tinel's Sign
- Phalen's Test
- Carpal Compression
- Reverse Phalen's Test
- Square Wrist Sign
- Closed Fist Test
- Two Point Discrimination

- Semmes-Weinstein Monofilament Test
- Abnormal Vibrotactile Sensitivity
- Tourniquet Test (Gilliat Test)
- Ultrasound Test
- Positive Hand Drawing Diagram of Katz
- Atrophy of Thenar Muscles
- Electrophysiological Test

Medical Causation

- Lanes, 1985, proposed that causal interference is not part of science at all, but lies in the domain of public policy.
- Hume, David. All knowledge is subjective

Post Hoc Ergo Propter Hoc

- A logical fallacy which assumes or asserts that if one event happens after another, then the first must be the cause of the second.
- Tempting Error: Temporal sequence is integral to causality

- A true cause always happens before its effect.
- Fallacy lies in coming to a conclusion based only on the order of events.
- Post Hoc Reasoning is related to the logical fallacy “Correlation implies Causation”, which is *cum hoc ergo propter hoc*

- Koch, 1882
- A.B. Hill, 1965
- Rothman, 1986 “an event, condition, or characteristic that plays a central role in producing the disease.”

- The World Health Organization has characterized “work related” diseases as multifactorial to indicate that a number of risk factors contribute to diseases
  - physical
  - work organizational
  - psychosocial
  - individual
  - sociocultural

NISOH surveillance case definition, if a worker has classic symptoms of carpal tunnel syndrome develop and has abnormal electrodiagnostic studies in the face of a work task that is highly forceful and repetitive, then the presumption is that the symptom complex is work related.

- There is evidence of a positive association between highly repetitive work alone or in combination with other factors and carpal tunnel syndrome.
- 30 studies reviewed, only 4 fulfilled epidemiological criteria

- Repetition: A cycle time less than 30 seconds or at least 50% of the work cycle spent performing the same fundamental movements
- There is also evidence of a positive association between forceful work and carpal tunnel syndrome.
- Force as defined by Silverstein et al in 1987 used 4 kg as the cut off point between high and low force.

- There is insufficient evidence of an association between carpal tunnel syndrome and extreme postures.

- Vibration: The NIOSH Criteria Document on exposure to hand-arm vibration [1989] quoted Taylor [1982] as follows: “It is not known whether vibration directly injures the peripheral nerves thereby causing numbness and subsequent sensory loss, or whether the para-anesthesia of the hands is secondary to the vascular constriction of the blood vessels causing is ischemia…in the nerve organs.

Estimating Risk

- Is the hand you primarily use to perform your current job?
- Do you bend your wrist more than twice a minute?
- Do you have repeated finger-tapping movement more than twice a minute?
- Do you spend more than four hours a day using your hands in the same fashion?
- Do you hold vibrating tools most of the day?

- Answers are directly proportional to the degree of risk.
- 2 is then low risk.
- 4 is moderate risk
- 5-6 is high risk

Non-Occupational Risk Factors

- Genetic Predisposition
- Body Mass Index (>29)
- Gender(Female)
- Other Medical Conditions(Diabetes)
- Psychosocial Factors

Risk:Coexisting Medical Conditions

- Diabetes
- Hormonal
  - Pregnancy
  - Therapy
  - Menopause
- Renal Disease
- Thyroid
- Inflammatory Arthritis
- Anatomic
- Gout
- Smoking
- Alcoholism

Risk: Anatomic

- Acute Trauma
  - Wrist Fractures
  - Dislocations
- Osteoarthitis
- Acromegaly
- Neoplasia

Risk: Psychosocial Factors

- Work Conditions
  - Monotony
  - Relationships
  - Job Security
  - Other (Pay, Benefits…)
- Spousal Disability

- Can not identify any specific work-related activity that may predispose to bilateral carpal tunnel syndrome.
- Each hand appears to have an independent risk
- Bilateral CTS should consider systemic medical conditions

Impairment Rating

- Can a person be at maximum medical improvement without surgery?
- Yes, In Section 2.5g. “A patient may decline surgical, pharmacologic, or therapeutic treatment of impairment. If a claimant declines treatment for a permanent impairment, that decision neither decreases or increases the estimated percentages of impairment that is present

- If there are residual physical or electrophysiological defects, the impairment is rated according to the methods found in Section 16.5 of the Guides to Impairment, 5th Edition. (480-492)
- Diminished sharp-dull sensation or the patient reports diminished sensation cannot be used for impairment rating

- Sensory defects are rated using Table 16-10.
- Motor and loss of power is rated by Table 16-11.
- Weakness is rarely worse than a Grade 4
- Motor and loss of power is rated by Table 16-11.

- Patients with believable symptoms and a normal nerve conduction delay have 0% impairment.
- Patients with normal distal motor and distal peak sensory latencies which (conduction delay), have abnormalities only on inching studies should be considered normal and have no impairment.

- There is normal sensibility and opposition strength but abnormal sensory and/or motor latencies (conduction delay) a very common scenario in post operative carpal tunnel release.
- A rating not too exceed 5% upper extremity impairment may be awarded.

- The decision should reflect the severity of the medical condition and the degree to which the impairment decreases the patient's ability to perform common activities of daily living excluding work Table 1-2, page 4 of the Guides

- Normal sensation, thenar muscle strength and normal nerve electrophysiological test has an impairment rating of 0%
- Note*: neither true sensory loss nor motor weakness occur with normal electrophysiological studies*

Impairment Findings

CTS Symptoms	Clinical Findings	Positive EMG or NCV Findings	Surgery	Chapter Discussed	IR
Yes	No	No	No	Upper extremity (UE)/nervous system	0%
Yes	Yes	No	No	Nervous system/UE	>0%
Yes	No	No	Yes	UE	0%
Yes	No	Yes	Yes	Nervous system/UE	>0%
No	No	Yes	No	Nervous system/UE	0%
No	No	Yes	Yes	UE	0%
Yes	No	No	Yes	Nervous system/UE	0%