

OCCUPATIONAL HAND SYNDROMES



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PRESENTER DISCLOSURE

I have the following relationships with commercial interests:

- Research: Smith+Nephew
 - Single center prospective randomized control trial on negative pressure wound therapy for incisions following major lower-limb amputation to reduce surgical site infection
 - A Single Centre Clinical Evaluation of a new NPWT dressing

OCCUPATIONAL HAND SYNDROMES: WHY IS IT IMPORTANT?

- Major societal problem, resulting in significant disability, cost and loss of productivity
- 2015 US Bureau of Labor Statistics: Injuries sustained from repetitive motion often result in longer duration of time away from work compared with other classes of injury

BOX 184.1 Arterial Disorders Associated with



Occupational or Recreational Activities

Manual Labor

Hand–arm vibration syndrome Hypothenar hammer syndrome



Exposure

Acro-osteolysis

Electrical burns

Extreme thermal injuries

Athletic

Chronic hand ischemia

Quadrilateral space syndrome

Humeral head compression of the axillary artery

Thoracic outlet syndrome

MANUAL LABOUR:

HAND-ARM VIBRATION SYNDROME

HYPOTHENAR HAMMER SYNDROME

HAND-ARM VIBRATION SYNDROME (HAVS)

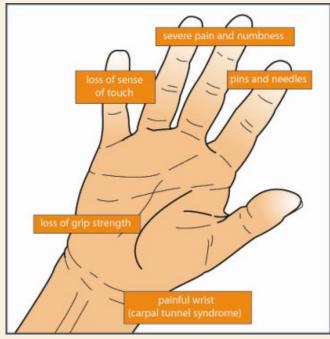
- A disease of many names:
 - Dead finger
 - Raynaud of Occupational Origin
 - Traumatic Vasospastic Disease
 - Vibration-Induced White Finger
- Most common initial symptoms: Raynaud phenomenon with history of prolonged use of vibrating mechanical tools



HAVS: CLINICAL FINDINGS

- Distal tips of one or more fingers experience attacks of cold-induced, vasospastic blanching
- Attacks last one hour and terminate with reactive hyperemia and significant pain
- Prolonged cold exposure may induce bluish black cyanosis in affected fingers
- 1% of cases progress to ulceration or gangrene





HAVS: RISK FACTORS

- Prolonged exposure to handheld vibrating machines or situations in which workers' hands are subjected to transmission of vibration energy
- Intensity of vibration
- Symptoms of HAVS have been correlated with:
 - Smoking
 - Lower levels of serotonin
 - Polymorphism variants of HTRIB gene

HAVS: MECHANISM OF INJURY

- Exact mechanism unknown
- Frequency and intensity of vibration affect extent of damage to endothelium
- Platelet adhesion
- Sympathetic hyperactivity + local factors = finger blanching attacks
- Vibrational energy releases endothelin-I

HAVS: DIAGNOSIS

- History of vibrating tool use and symptoms of Raynaud phenomenon
- For vasospastic condition: Cold provocation and recording of time until digital temperature recovers
- Digital artery occlusion: best detected by transcutaneous doppler ultrasound or duplex scanning of affected fingers
- Advanced disease: arteriography
- MRI can be used to differentiate HAVS from hypothenar hammer syndrome

Stockholm Workshop Scale for the Classification of Hand–Arm Vibration Syndrome

Stage	Grade	Description
0		No attacks
1	Mild	Occasional attacks affecting only the tips of one or more fingers
2	Moderate	Occasional attacks affecting distal and middle (rarely also proximal) phalanges of most fingers
3	Severe	Frequent attacks affecting all phalanges of most fingers
4	Very Severe	As in Stage 3, with trophic skin changes in the finger tips

Modified from Gemne G, Pyylo I, eds. The Stockholm Workshop scale for the classification of cold-induced Raynaud's phenomenon in the hand-arm vibration syndrome. *Scan J Work Environ Health*. 1987;13(4):275–278.



FIGURE 184.1 Arteriogram of the Hand in a Vibratory Tool Worker.Occlusion of the digital arteries *(arrow)* is apparent.

ARTERIOGRAPHIC CHANGES

Multiple segmental occlusions of the digits

Corkscrew configuration of vessels in the hands

Extent of digital artery occlusion dependent on frequency and duration of exposure

HAVS: TREATMENT AND PREVENTION

- Discontinuation of vibratory tools
- Smoking cessation
- Advanced cases: consider calcium channel blockers
- IV infusion of prostanoid (prostaglandin EI, prostacyclin, iloprost) reserved for digital gangrene
- Surgical treatment (cervical sympathectomy, digital sympathectomy) rarely needed
- Prevention more effective than treatment
 - Personal protective equipment: antivibration gloves
 - Standards limiting dose and duration of vibration exposure



MANUAL LABOUR:

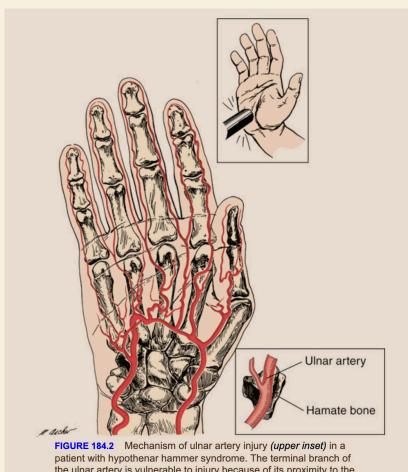
HAND-ARM VIBRATION SYNDROME

HYPOTHENAR HAMMER SYNDROME

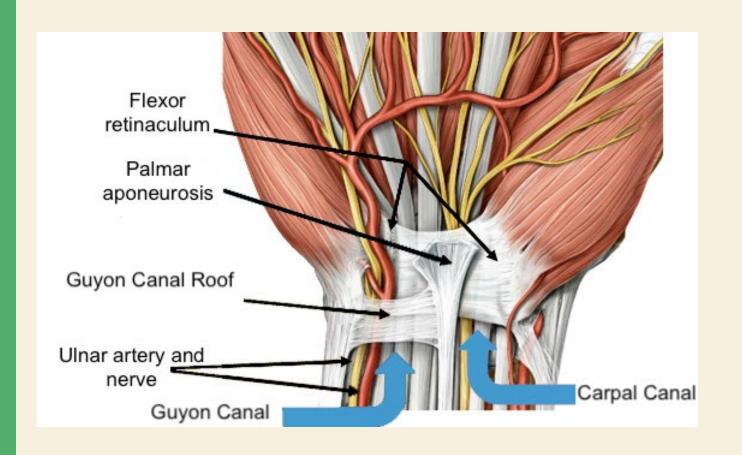
HYPOTHENAR HAMMER SYNDROME

- Ulnar artery at hypothenar eminence is vulnerable to injury with repetitive pushing, pounding or twisting
- Mechanics, factory workers, carpenters, masons

• Rare entity, however likely has a larger incidence than known due to cases going unrecognized



the ulnar artery is vulnerable to injury because of its proximity to the hamate bone (lower inset).



ANATOMY OF HYPOTHENAR HAMMER SYNDROME

Ulnar artery and nerve travel in Guyon bound by the pisiform and hamate bones

In this region, ulnar artery superficial

Use of the palm as a hammer compresses the artery against the hook of the hamate bone

HYPOTHENAR HAMMER SYNDROME: MECHANISM OF INJURY

- Type of arterial abnormality depends on nature of vessel injury
- Vasospasm and damage to intima results in platelet aggregation and thrombus formation
- Damage to media leads to aneurysmal degeneration of the artery (less frequent)
- Thrombus formation can occur within aneurysm leading to **distal embolization**



FIGURE 184.3 Open surgical repair of an ulnar artery aneurysm from hypothenar hammer syndrome. Note the aneurysm of the ulnar artery caused by repetitive trauma.

HHS: CLINICAL FINDINGS

- Male smokers
- Asymmetrical distribution: dominant upper extremity
- Present with Raynaud phenomenon affecting the ulnar three fingers
- Cyanosis and pallor phases can occur
 - lack of hyperemic redness
- Physical exam:
 - Cool/mottled digits
 - Ischemic ulcers may be present over hypothenar eminence in severe cases
 - Positive Allen test
 - Pulsatile mass in hypothenar eminence

HHS: DIAGNOSTIC IMAGING

- Arteriography is gold standard imaging modality
- Corkscrew pattern typically seen in affected vessels
- Include proximal arterial segments in imaging to rule out upstream sources of embolization

HHS: TREATMENT

- Optimal treatment options controversial
- Majority of patients improve with nonsurgical interventions
 - Smoking cessation
 - Hand protection with avoidance of exposure to cold environments
 - Avoidance of further trauma
 - Calcium channel blockers
 - Antiplatelet agents
- Surgery reserved for severe cases of digital ischemia or presence of aneurysm

EXPOSURE INJURIES

 OCCUPATIONAL ACRO-OSTEOLYSIS

ELECTRICAL BURNS

• EXTREME THERMAL INJURIES

OCCUPATIONAL ACRO OSTEOLYSIS

- Seen in workers involved in the production of polyvinal chloride (PVC)
- Causes bony resorption of the distal phalanges similar to scleroderma
- Dominant initial symptom: Raynaud-like vasospasm
- Angiography demonstrates:
 - multiple stenoses and occlusions of the digital arteries
 - nonspecific hypervascularity adjacent to the areas of bone resorption
- Digits may have clubbing
- Treatment: Supportive

ELECTRICAL BURNS

- Electrical energy causes tissue destruction in relation to voltage applied
- Currents less than 1000V cause injuries limited to the immediate underlying skin and soft tissue
- High voltage (>1000V) causes extensive damage
- Hand most commonly afflicted
- Manifests as arterial necrosis with thrombus or bleeding, potentially leading to gangrene and limb loss
- Arterial spasm can occur
- Over time, damage to media may cause aneurysm formation
- Traumatic limb treatment depends on concomitant electrical injury to bone and soft tissue
- Occlusion of a major artery requires bypass grafting

EXTREME THERMAL INJURIES

- Vasomotor disturbances in hands of those exposed to extreme chronic thermal trauma
- Typically manifest as Raynaud syndrome
- Workers at highest risk:
 - Slaughterhouses
 - Canning factories
 - Fisheries
- Risk factors:
 - Alternating ice-cold and hot exposure
 - Use of plastic gloves in cold exposure
 - Long-term exposure to cold
- Treatment: Supportive

THANK YOU

Yoo, T., & Eskandari, M. K. (2022 Conditions Arising from Repetitive Trauma and Occupational Vascular Problems. In A. N. Sidawy & B. A. Perler (Eds.), *Rutherford's Vascular Surgery and Endovascular Therapy* (10th ed., Ch. 184). Elsevier.