

# Carpal Tunnel: Hand Conditions and Clinical Management in Physical Therapy



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# Who am I?



## I am an Athletic Trainer

Athletic trainers are [AMA recognized] health care professionals who collaborate with physicians to optimize activity and participation of patients and clients.

Athletic training encompasses the prevention, diagnosis, and intervention of emergency, acute, and chronic medical conditions involving impairment, functional limitations, and disabilities.





# Learning Objectives

Upon completion of this course, the participant will be able to:

- Describe what carpal tunnel syndrome is.
- List and describe the possible causes of carpal tunnel.
- Discuss the role repetitive motion and cumulative trauma play in onset of carpal tunnel conditions.
- Describe comorbidities may predispose a person to carpal tunnel problems.
- Describe symptoms of carpal tunnel.
- Discuss conservative vs. surgical treatment options for carpal tunnel.
- Understand post-op OT plans, goals and durations
- Explain ergonomic workstation principles that apply to carpal tunnel injuries.



# Common Hand Conditions

- Cumulative Trauma
  - CTDs (cumulative trauma disorders)
  - RSIs (repetitive stress injuries)
  - RMIs (repetitive motion injuries)
- Compressive Neuropathies



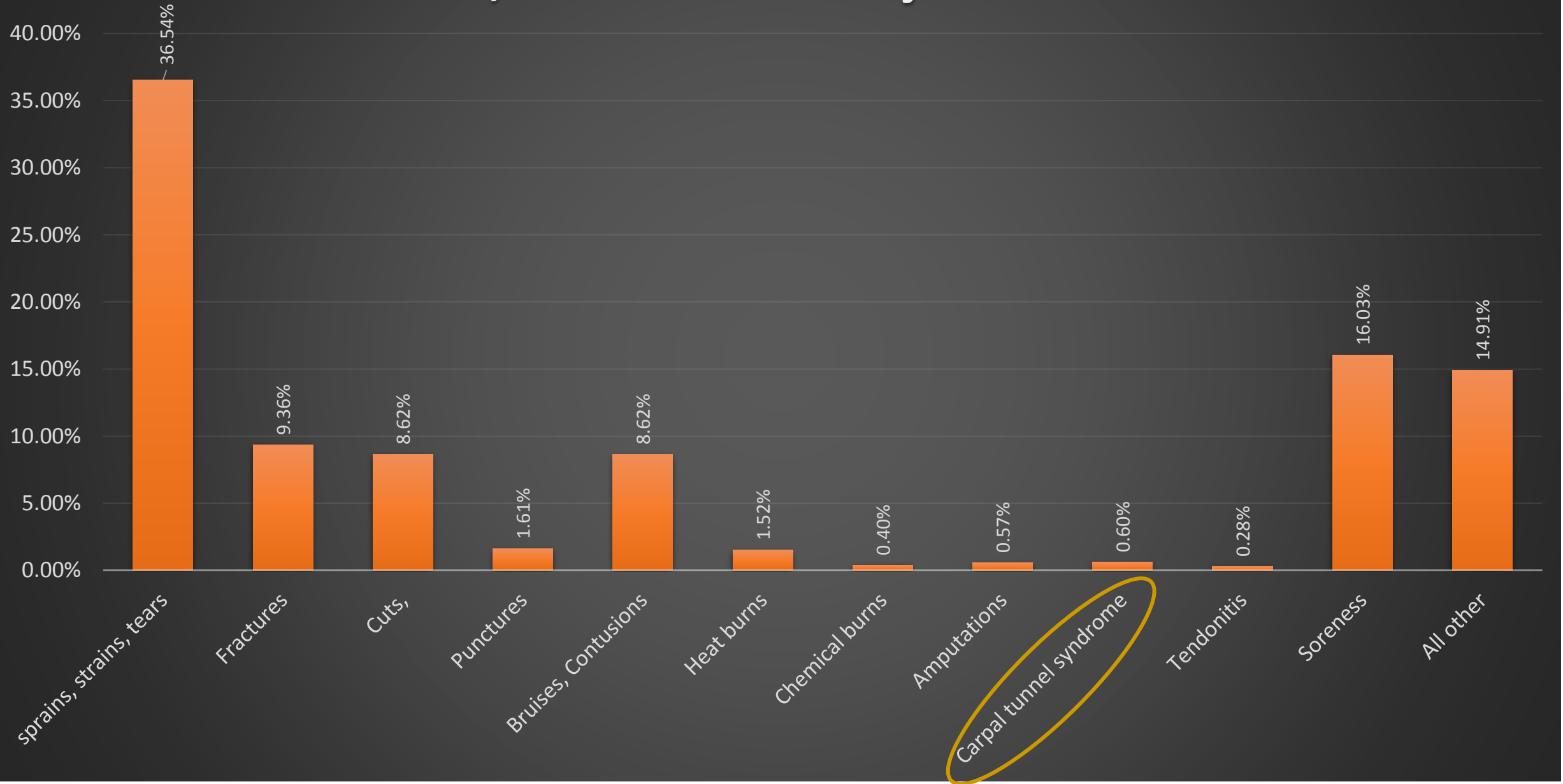
# [ Common Hand Conditions

## I. Compressive Neuropathies

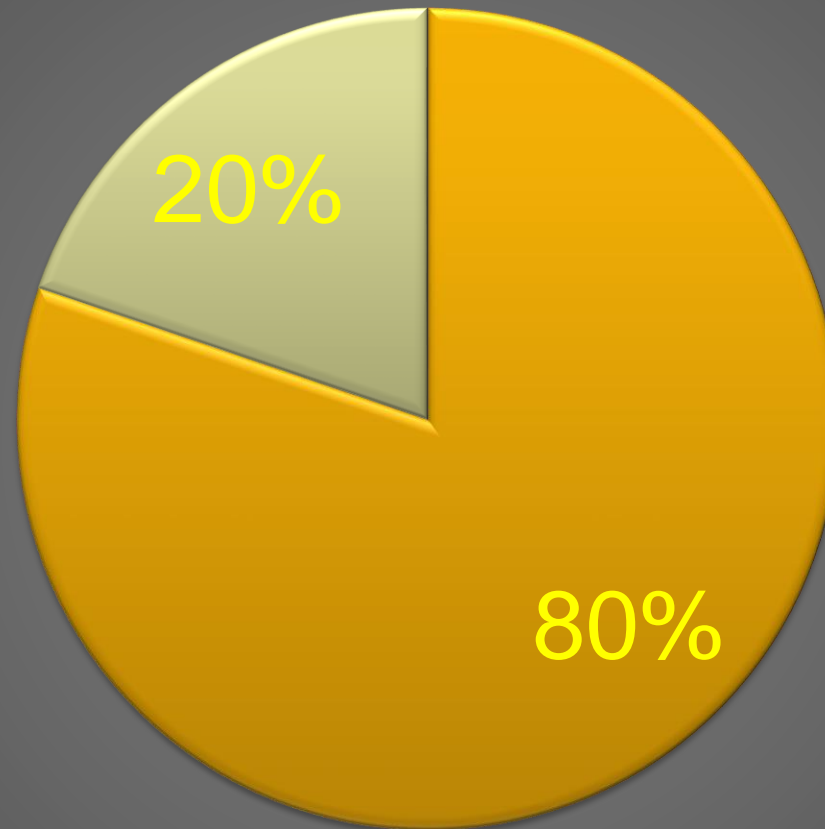
- Carpal Tunnel Syndrome
- Cubital Tunnel Syndrome



# Arm, Wrist & Hand Injuries 2016



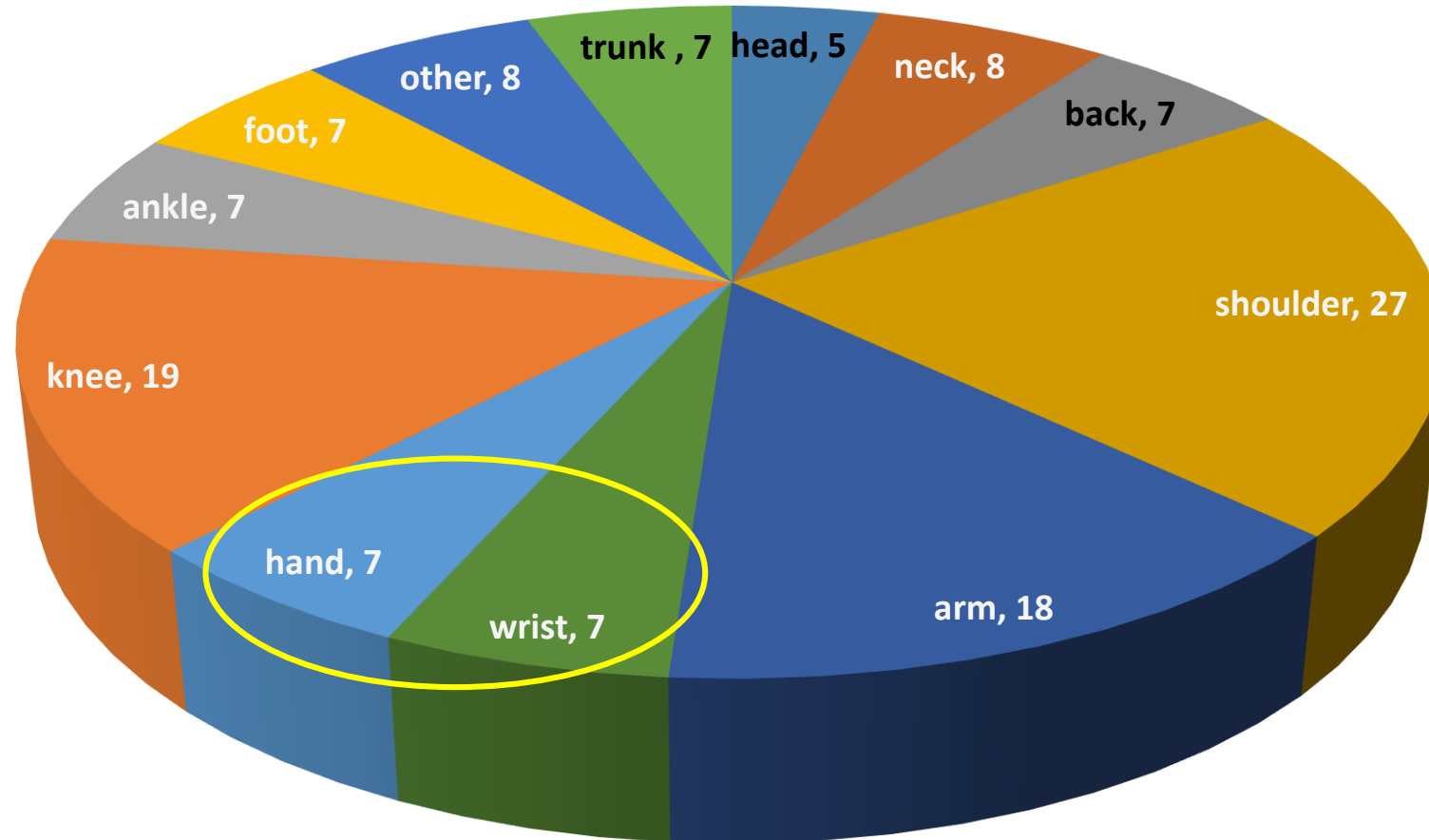
# Major Causes of MSD



- Overexertion in lifting or lowering
- Repetitive motion involving microtask

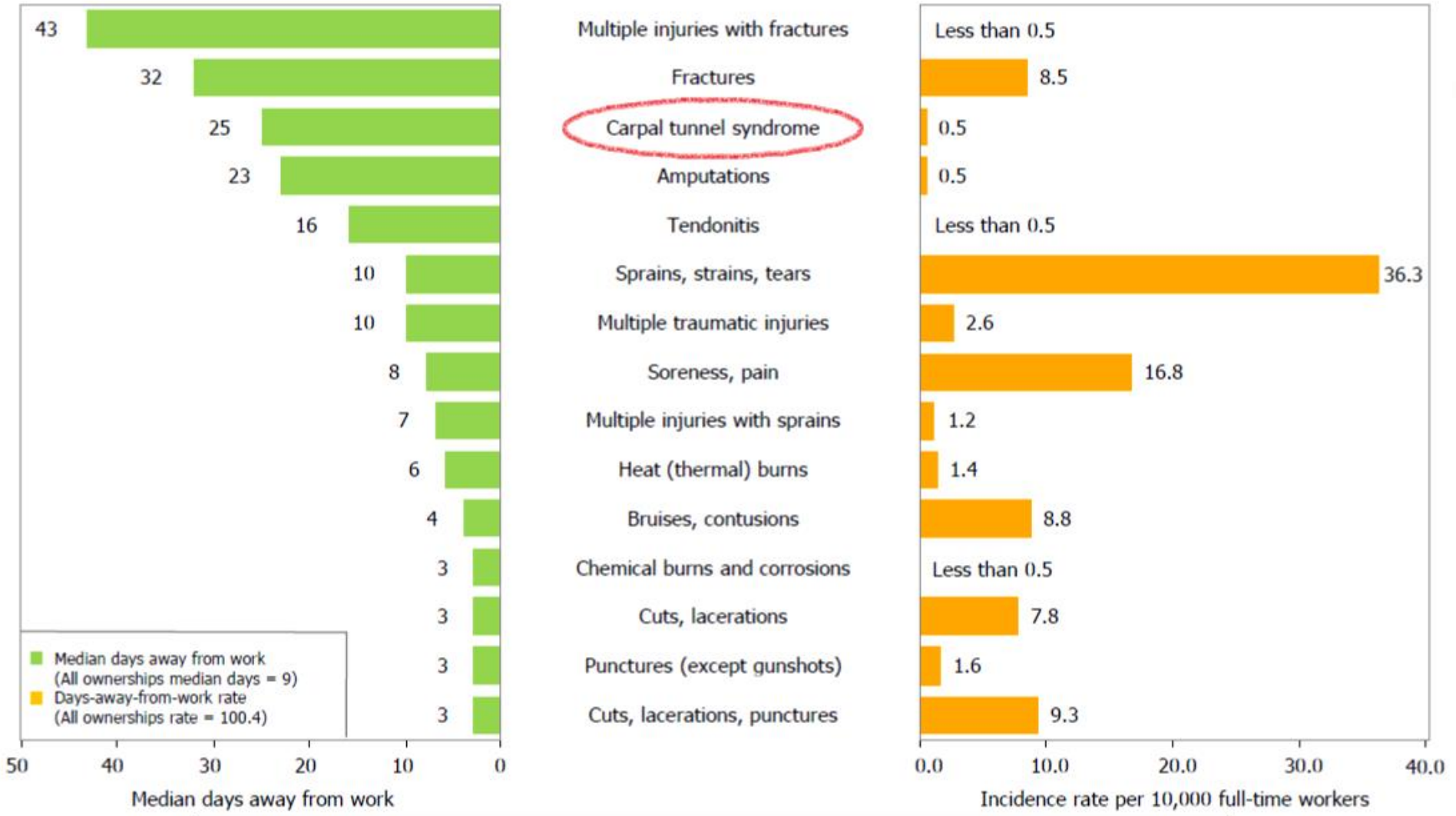


# Median Days Away from Work



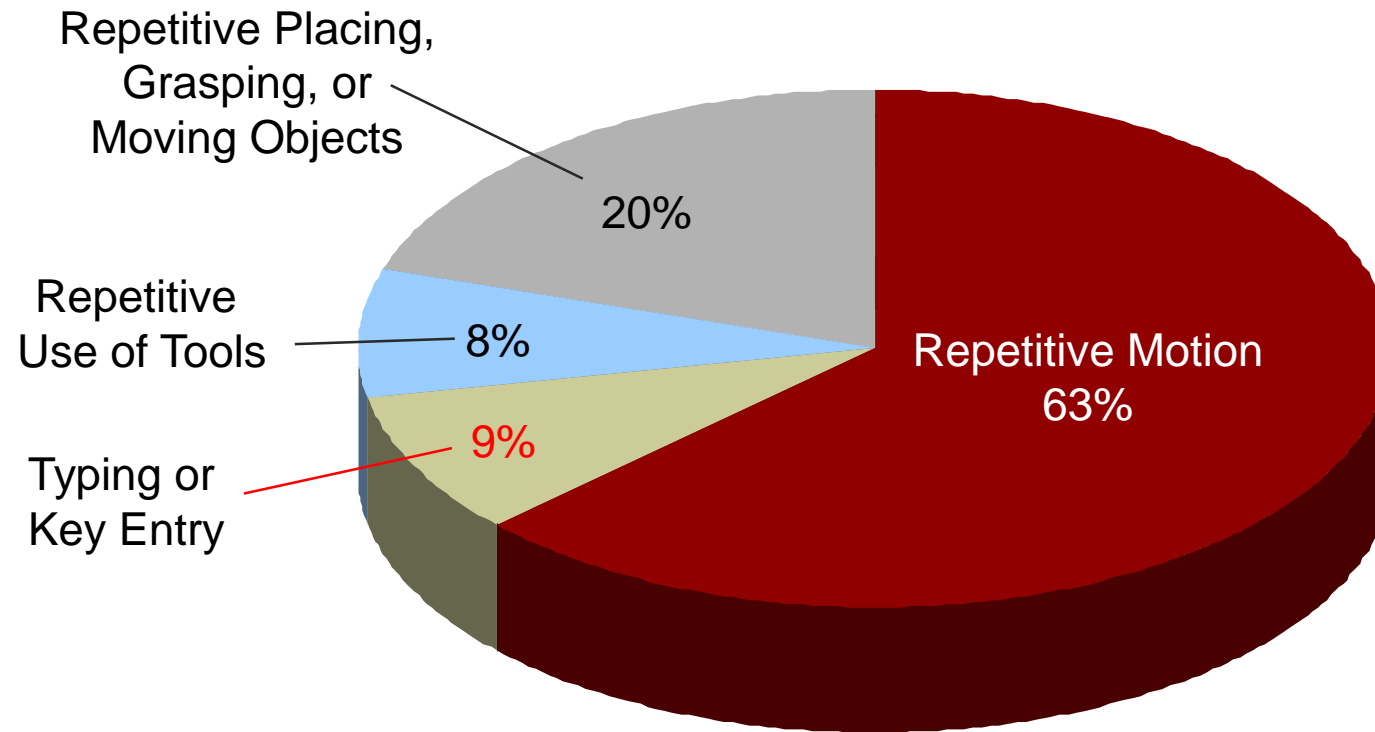


Median days away from work and incidence rates of nonfatal occupational injuries and illnesses by nature, all ownerships, 2016



In 2016, fractures and multiple injuries with fractures were the most severe types of nonfatal injuries or illnesses resulting in medians of 32 and 43 days away from work, respectively. Sprains, strains, and tears occurred at a rate of 36.3 cases per 10,000 full-time equivalent workers in 2016, down from 38.0 cases in 2015.

# MSD-Type Injuries





## Some MSD Statistics

- 365,580 cases, median 13 days away from work per case,
- 1 of every 3 dollars spent on workers compensation
- \$20 billion a year direct costs for MSD-related workers' compensation,
- \$100 billion for indirect costs
- substantial personal toll on affected workers





## More MSD Statistics

- More than 90 % of all office workers use a computer work station
- In 2014 MSDs accounted for 32% injury and illness cases
- Incidence rate decreased to 33.8 cases per 10,000 f-t workers (2013 it was 35.8 cases)
- Nursing assistants had highest number of cases (54% of total cases) in 2014

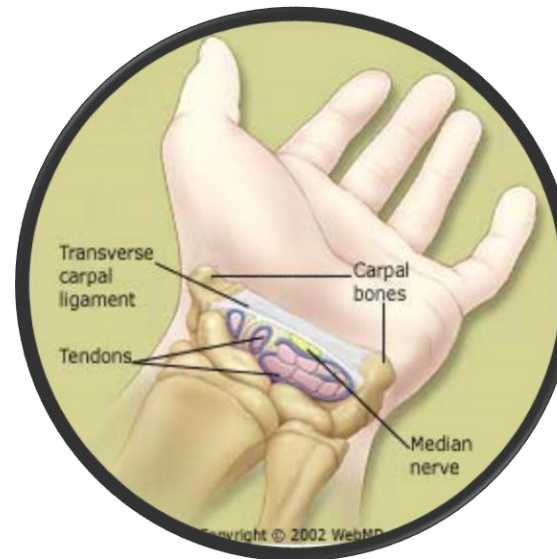


# Carpal Tunnel Syndrome

## Carpal Tunnel Syndrome

### Anatomy:

- Median nerve
- Tendons
- Carpal Ligament

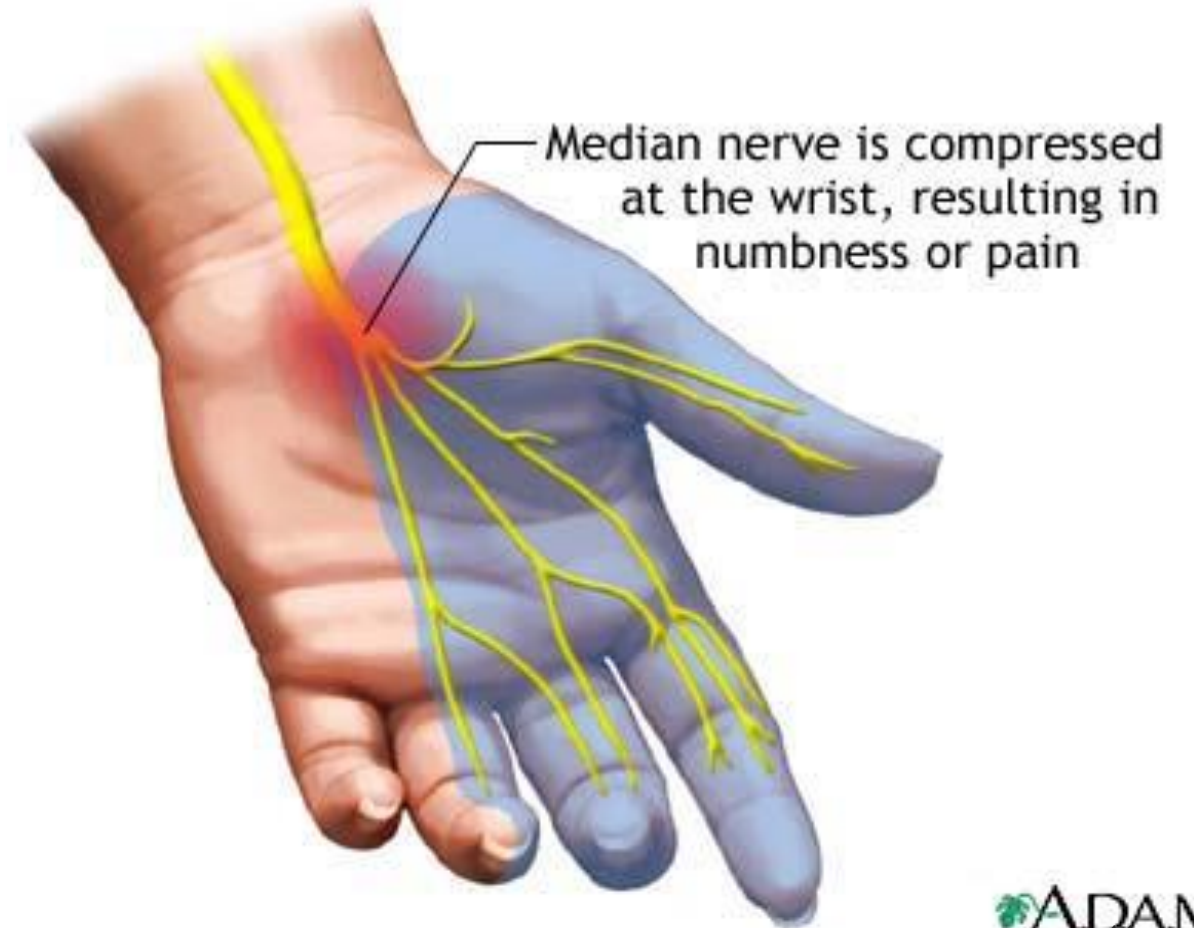




# [ Carpal Tunnel Syndrome

## Median Nerve Supply:

- Muscles:
  - Thumb
- Sensory branches:
  - thumb
  - index
  - long
  - ½ ring

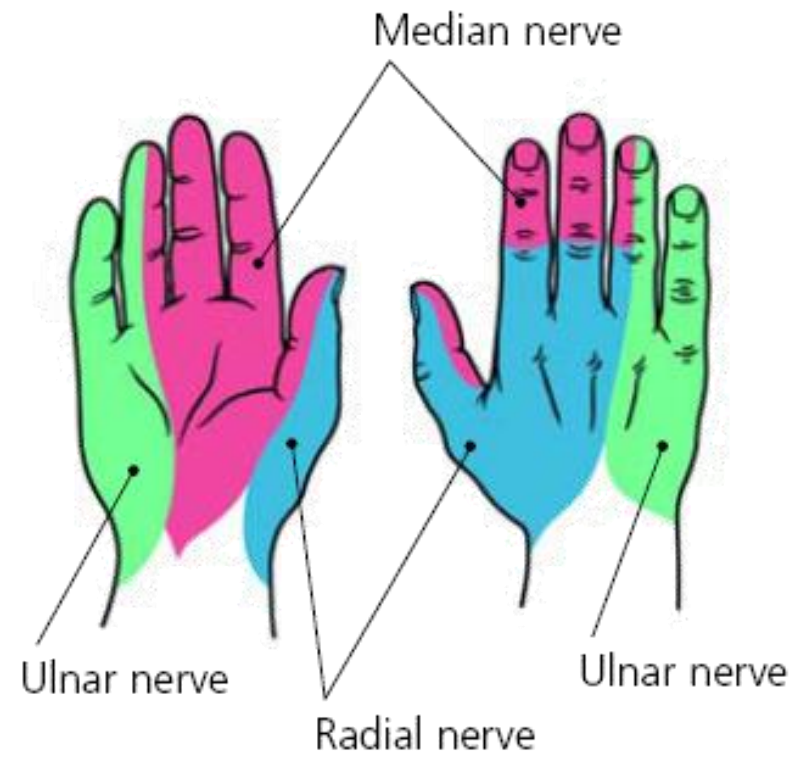




# Carpal Tunnel Syndrome

## Symptoms:

- Numbness and tingling in thumb, index, long and 1/2 ring fingers
- Pain and numbness at night
- Clumsiness and weakness
- Aggravated with prolonged use





# [ Carpal Tunnel Syndrome

## Symptoms:

- Pain and paresthesia may radiate to the forearm, elbow, and shoulder.
- Decreased grip strength
- Loss of dexterity







# [ Carpal Tunnel Syndrome

## Symptoms:

- Thenar muscle atrophy in severe cases



# Carpal Tunnel Syndrome



## Outward Signs:

- Cradling arms
- Massaging hands, wrists, or arms
- Vigorously shaking hands
- Flick Sign





# Carpal Tunnel Syndrome

## Causes:

- Gradual compression of the median nerve in the carpal tunnel.
- Repetitive motion irritates the tendons causing the lining around the tendons to swell decreasing the space in the tunnel.

## Systemic Causes:

- Diabetes Mellitus (DM);
- Rheumatoid Arthritis (RA);
- Gout;
- Hypothyroidism;
- Pregnancy



# Carpal Tunnel Syndrome

## Conditions That Predispose:

- Alcoholism
- Renal failure
- Benign tumors (lipomas, ganglion cysts)
- Trauma to the wrist such as a distal radius fracture - red flag





# Carpal Tunnel Syndrome

## Risk Factors:

- Highly repetitive work
- Prolonged forceful gripping
- Use of vibratory or pneumatic tools
- Contact stress (pressure points)
- Awkward postures
- Occurs more in women
- Increased incidence with obesity



[ **FACT**

The average person working at a keyboard can perform **50,000** to **200,000** keystrokes a day





# Risk Factor— Repetitive Motion

## Contributing factors:



Image credit: *Business & Legal Reports*

- Duration and speed of repetitious movement
- Number of muscles involved
- Required force



# Risk Factor: Forceful Exertions

## Contributing factors:

- Type of grip
- Weight of object
- Body posture
- Type and duration of the task

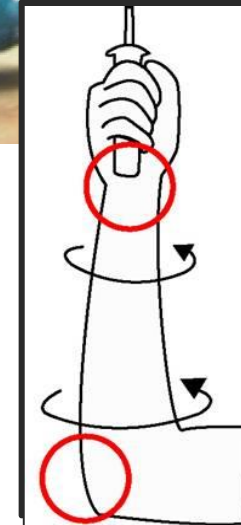


Image Credit: OSHA



# Risk Factors: Contact Stress



Image credit: *Business & Legal Reports*

## Contributing factors:

- Pressing against or grabbing a hard object
  - puts pressure on nerves, tendons, and blood vessels
  - Repetition
  - Duration of contact
  - Grip strength required



# Characteristics of Cumulative Trauma

- Occur from many small injuries
- Take weeks, months, or years to develop
- Produce no symptoms in early stages, but show symptoms after injury has occurred
- Contributing causes may occur at home and at work
- Same CTD may differ in severity from person to person doing a similar task

## [ CTD: Two elements are at work. ]

- 1) *Static work*: musculoskeletal effort required to hold a certain position, even a comfortable one.

**Example:** sit & work at computers; keeping head and torso upright requires small or great amounts of static work depending on the efficiency of the body positions we chose.

## Elements at work (cont.)

2) **Force**: amount of tension our muscles generate

Example: tilting your head forward or backward from a neutral, vertical position *quadruples* the amount of force acting on your lower neck vertebrae

- Increased force is d/t increase in muscular tension needed to support head in a tilted position



## 3 Main Ergonomic Principles:

- 1) Work activities should permit worker to adopt several different healthy and safe postures.
- 2) Muscle forces should be done by the *largest appropriate* muscle groups available
- 3) Work activities s/b performed with joints at about mid-point of their ROM (esp. head, trunk, UE)

# [ FACT

**Overuse** and small repetitive movements ie: CTD, RSI, RMI **disturb balance** of muscles, tendons, ligaments and nerves



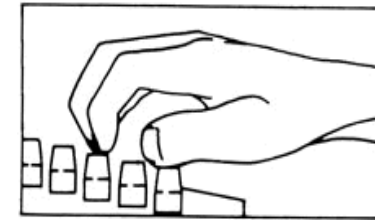


# Case Study: Carpal Tunnel Syndrome

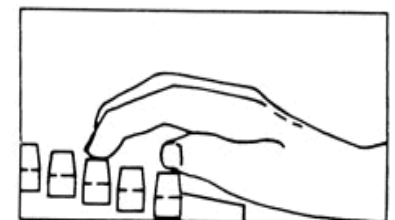
## Example:

### Administrative Assistant

- Repetitive Typing with wrist slightly bent for prolonged periods
- Resting wrists heavily on wrist rests decreases space in the carpal tunnel increases pressure on the median nerve.



right



wrong

# Case Study: Carpal Tunnel Syndrome



Example:

## Custodian

- Forcefully grips mop or broom over time develops thickening of the tendons decreasing space in the carpal tunnel and increasing pressure on the median nerve

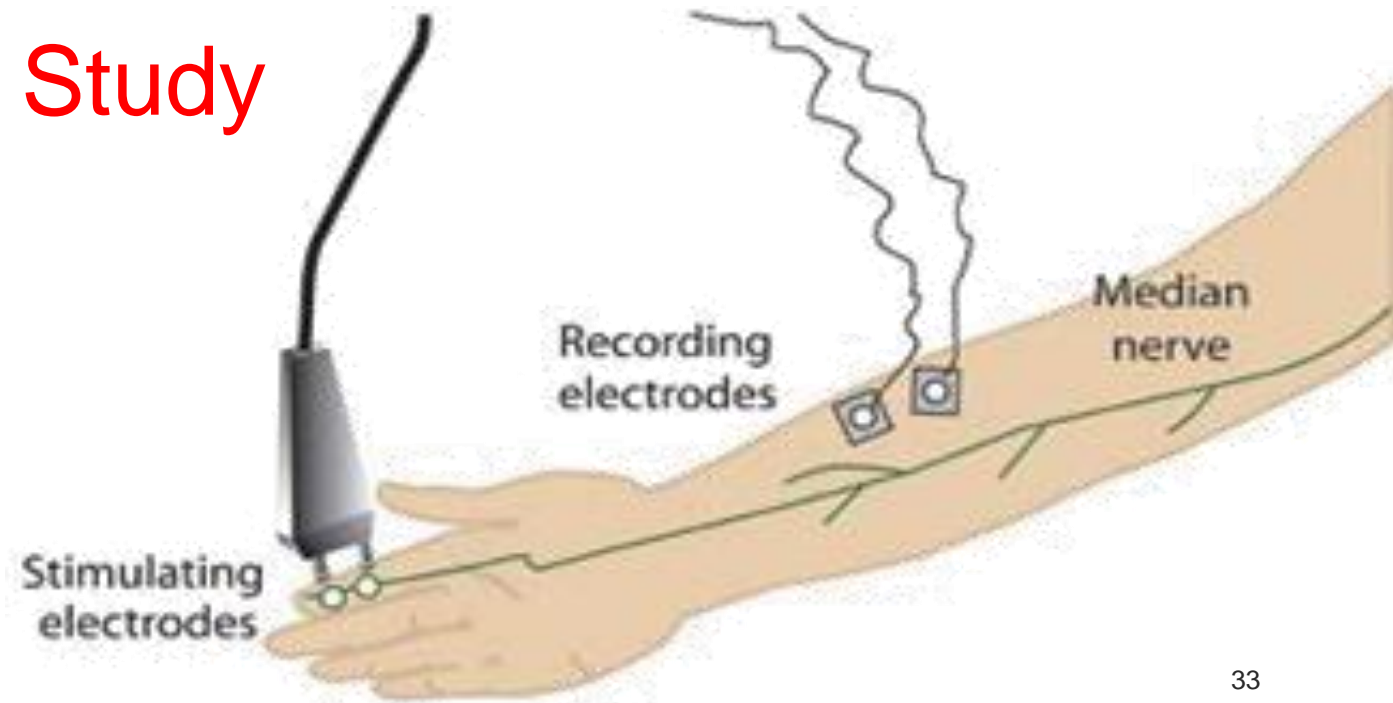






# [ Carpal Tunnel Dx

- History
- Physical examination
- **Nerve Conduction Study**





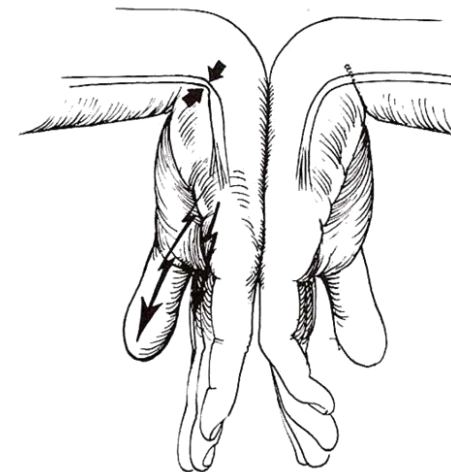
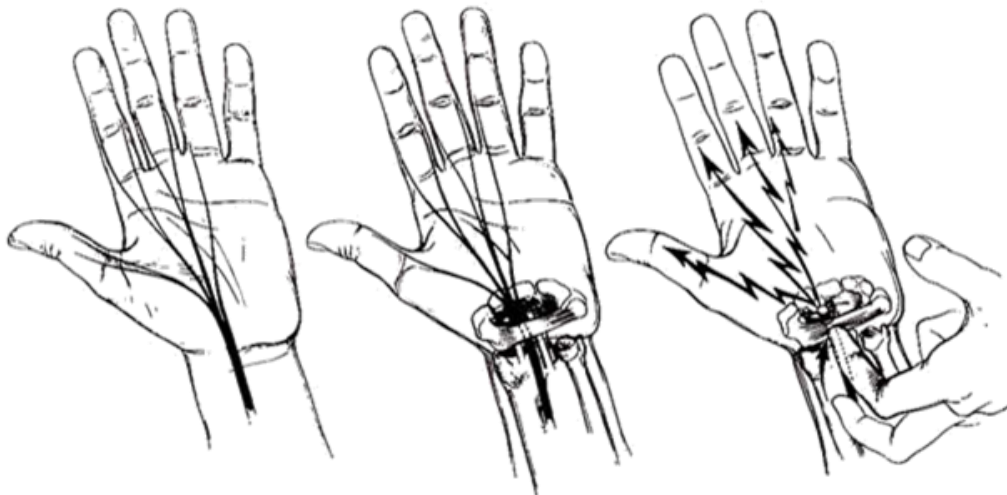
# [ Carpal Tunnel Syndrome

## Physical Evaluation:

- R/O cervical spine problems
- Special Tests
  - Tinel's sign

&

Phalen's test



# Carpal Tunnel Syndrome: Special Tests



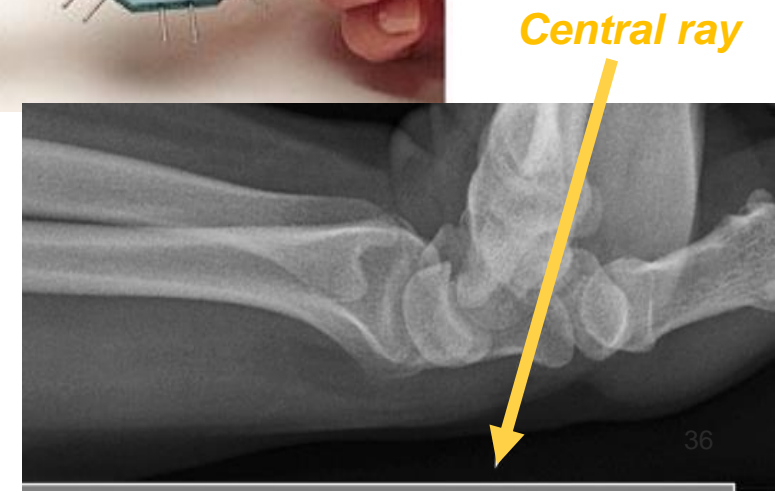
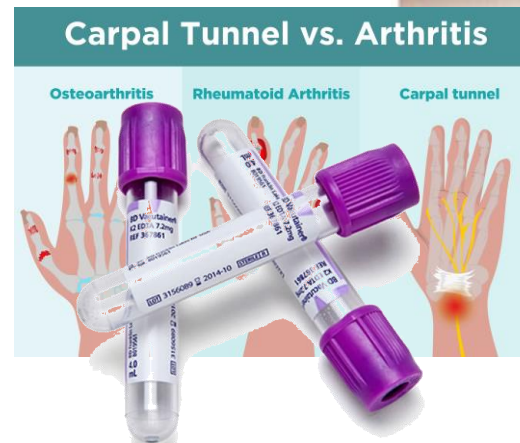
Test	Sensitivity (%)	Specificity (%)
Tinel's test	82.2	88.9
Phalen's test	84.4	86.7
Carpal compression test	84.4	82.2
Hand elevation test	86.7	88.9



# Carpal Tunnel Syndrome

## Physical Evaluation:

- Strength Test
- Sensory Test
- Lab Tests
- X-ray - normal





# Carpal Tunnel Syndrome

evaluation continued:

- EMG - Nerve Conduction Study– Gold Standard\*
- EMG – tests nerve function
- Identifies site of compression
- Pt can have a negative EMG test and still present with clinical signs and symptoms

# Carpal Tunnel Syndrome



## Conservative Treatment:

- Night splint in neutral (pre-fabricated)
- NSAIDs
- Vitamin B6
- Diuretics
- Injection
- Refer to Hand Therapy





# Carpal Tunnel Syndrome

## Hand Therapy Conservative Treatment:

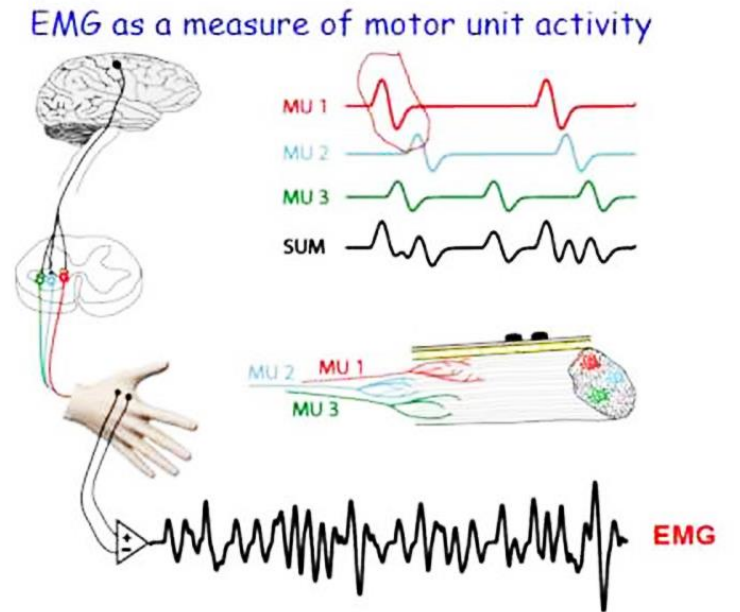
- Hand Therapy Length (No more than a few visits)
- Night splints (custom-made)
- Ergonomics- Posture/Positioning for specific jobs, ADLs and sleep
- Exercises- Ice
- Iontophoresis (Steroid with current)



# Carpal Tunnel Syndrome

## Surgical Indications:

- EMG results – positive
- Obvious weakness, numbness, and muscle wasting
- Clinical symptoms correlate with tests
- Injection works temporarily







# Carpal Tunnel Surgery

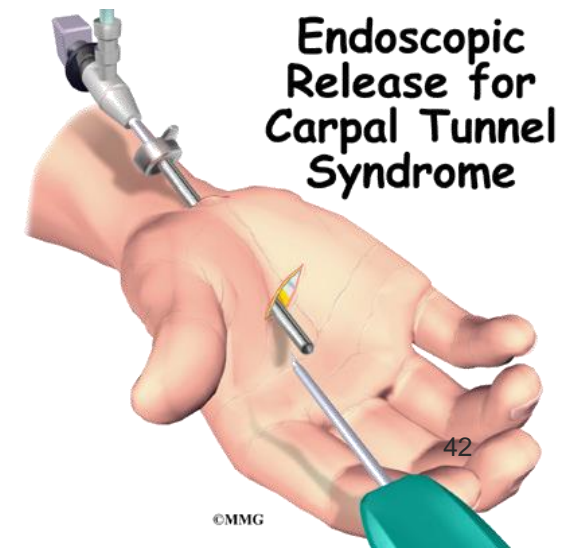
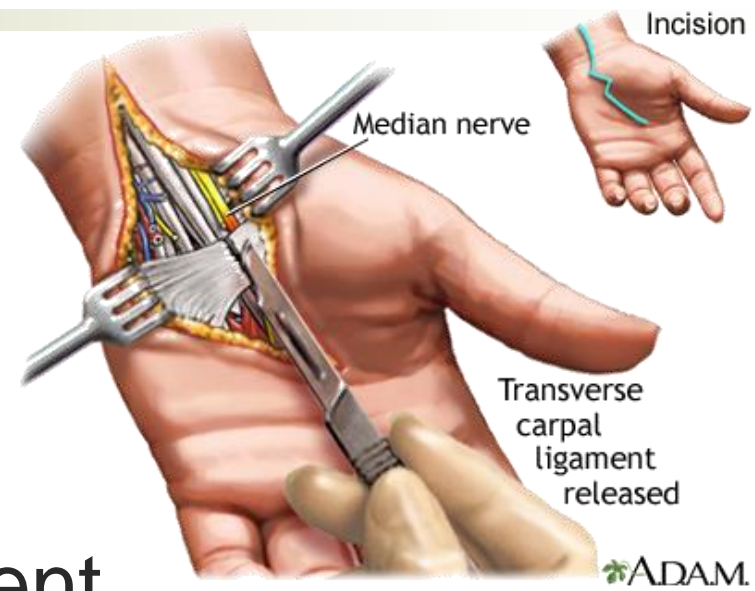
- Recommended for:
  - patients with symptoms that do not respond to conservative measures and in
  - patients with severe nerve entrapment as evidenced by nerve conduction studies, thenar atrophy, or motor weakness.
  - may be effective even if a patient has normal nerve conduction studies

# Carpal Tunnel Syndrome



## 2 Types of Carpal Tunnel Releases

1. Open incision technique
  2. Endoscopic release
- Both divide the carpal ligament releasing pressure on the median nerve
  - Both have a high rate of success





# [ Carpal Tunnel Syndrome R<sub>x</sub> & T<sub>x</sub> ]

## Hand Therapy Post Operative Treatment:

Hand Therapy Length (4-6 weeks)

Week 2:

- Range of motion, scar management; Edema control, desensitization

Week 4:

- Strengthening; UE conditioning; Work simulated tasks- or return to light work

Week 6:

- Return to work depending on type of job



# [ Carpal Tunnel Syndrome

## Complications:

- Some people with long standing carpal tunnel do not have significant relief after surgery because the nerve has been permanently damaged from constant pressure for a long period of time.



# Carpal Tunnel Surgery

- Complications of surgery
  - Injury to the palmar cutaneous or recurrent motor branch of the median nerve
  - Hypertrophic scarring
  - Laceration of the superficial palmar arch
  - Tendon adhesion
  - Postoperative infection
  - Hematoma
  - Arterial injury
  - Stiffness

## Predicting the Outcome of Conservative Treatment for Carpal Tunnel Syndrome



Score 1 point for each “yes” answer and zero for each “no” answer. See the scoring key for the predicted successful outcome of conservative treatment.\*

1. Have symptoms been present for more than 10 months? Yes \_\_\_\_\_ No \_\_\_\_\_
2. Does the patient have constant paresthesias? Yes \_\_\_\_\_ No \_\_\_\_\_
3. Does the patient have flexor tenosynovitis (“triggering” of the digits)? Yes \_\_\_\_\_ No \_\_\_\_\_
4. Is Phalen’s maneuver positive within less than 30 seconds? Yes \_\_\_\_\_ No \_\_\_\_\_
5. Is the patient older than 50 years? Yes \_\_\_\_\_ No \_\_\_\_\_

SCORING KEY: zero points = 65% success rate; 1 point = 41.4% success rate; 2 points = 16.7% success rate; 3 points = 6.8% success rate; 4 or 5 points = 0% success rate.

\*—Outcome rates are based on the use of wrist splinting and nonsteroidal anti-inflammatory drugs; success rates may be higher with oral corticosteroid therapy or local corticosteroid injection.

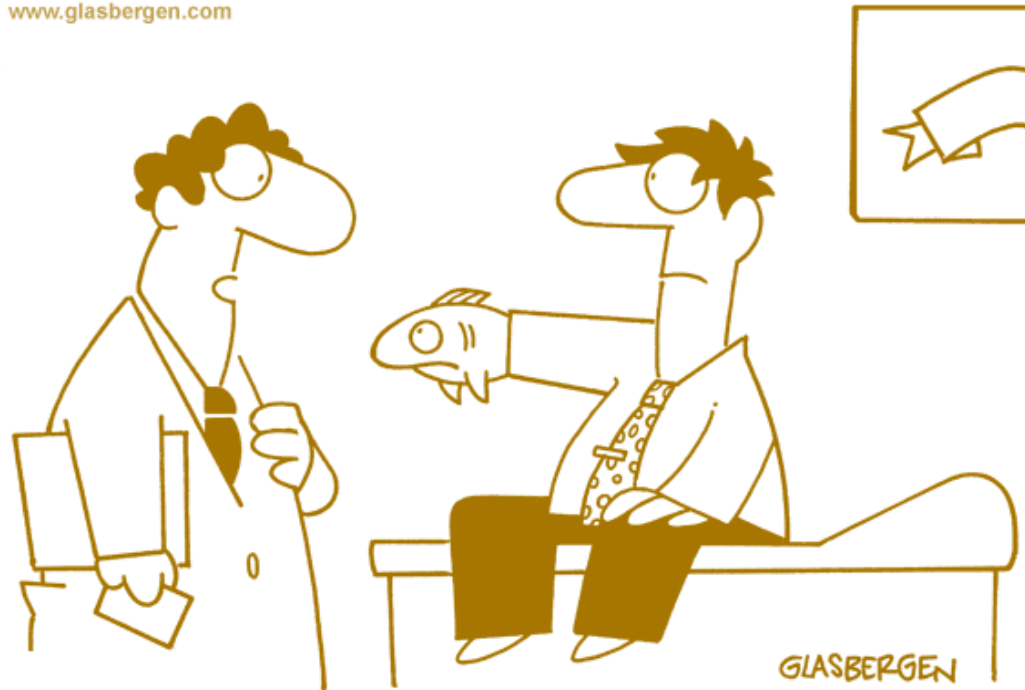


# [ General Measures

- Avoid repetitive wrist and hand motions that may exacerbate symptoms or make symptom relief difficult to achieve.
- Avoid using tools that vibrate
- Ergonomic measures to relieve symptoms and minimize aggravating

# Carpal Tunnel: Preventative Conditioning

Copyright 2006 by Randy Glasbergen.  
[www.glasbergen.com](http://www.glasbergen.com)



“Carp tunnel syndrome.”

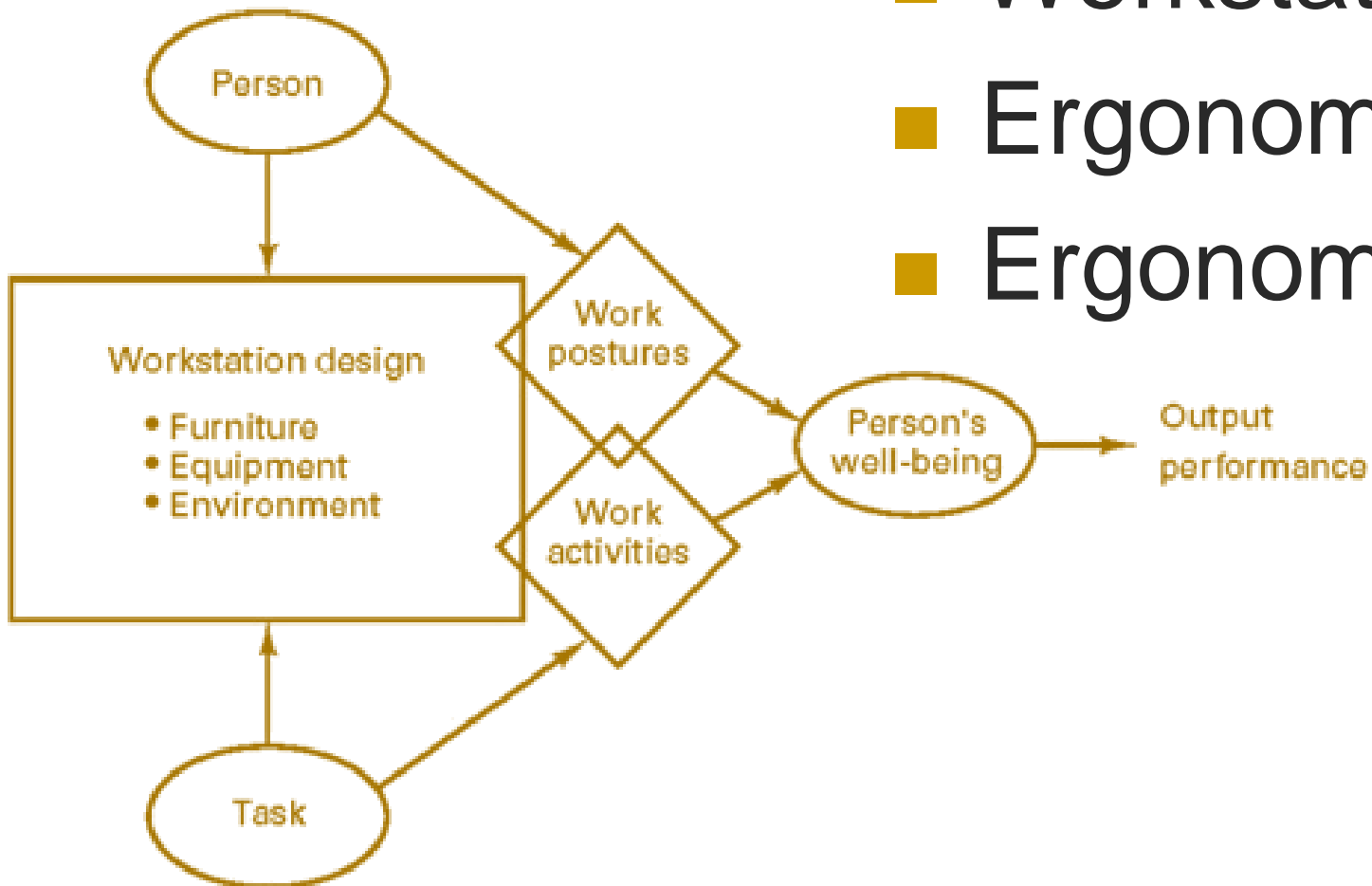






# Preventing Carpal Tunnel

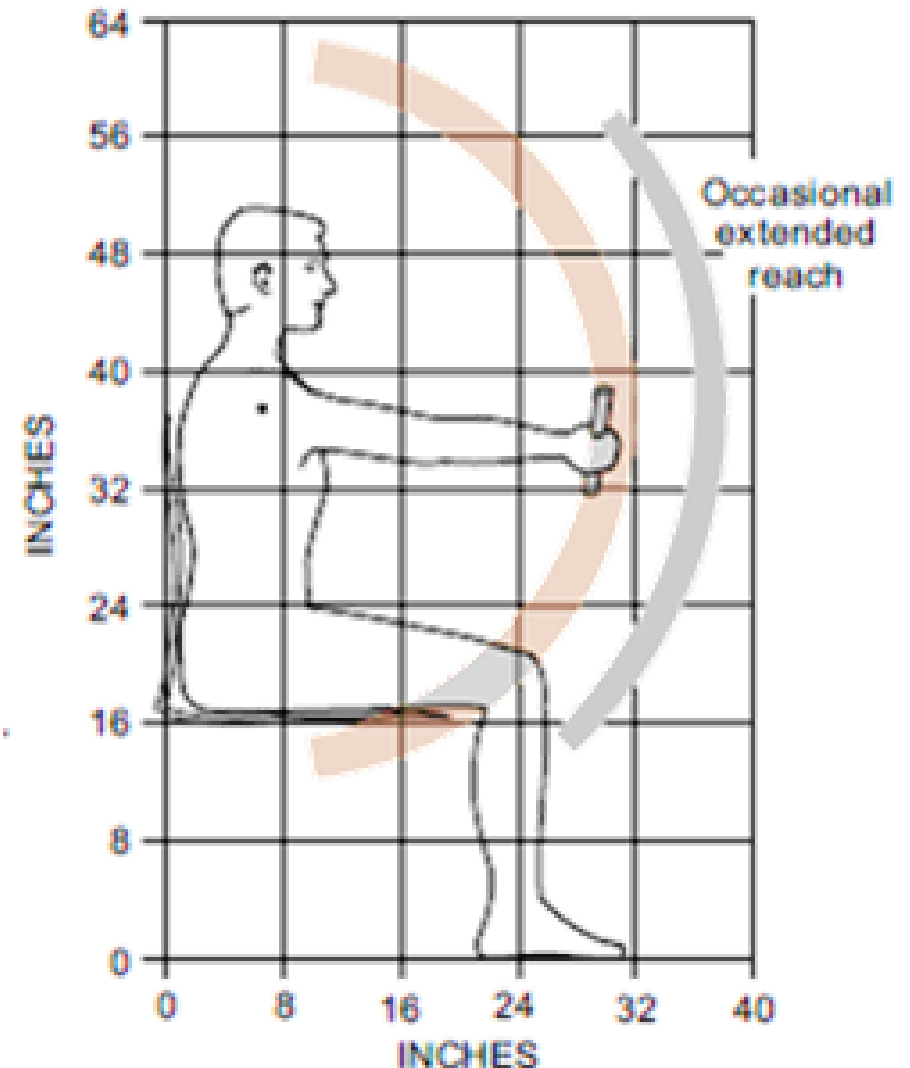
- Workstation Design
- Ergonomic Positioning
- Ergonomic Tool Design





# Evaluating Job Risk Factors: Seated Work

- Seated Work: Boundaries for vertical reaches for grasping objects.

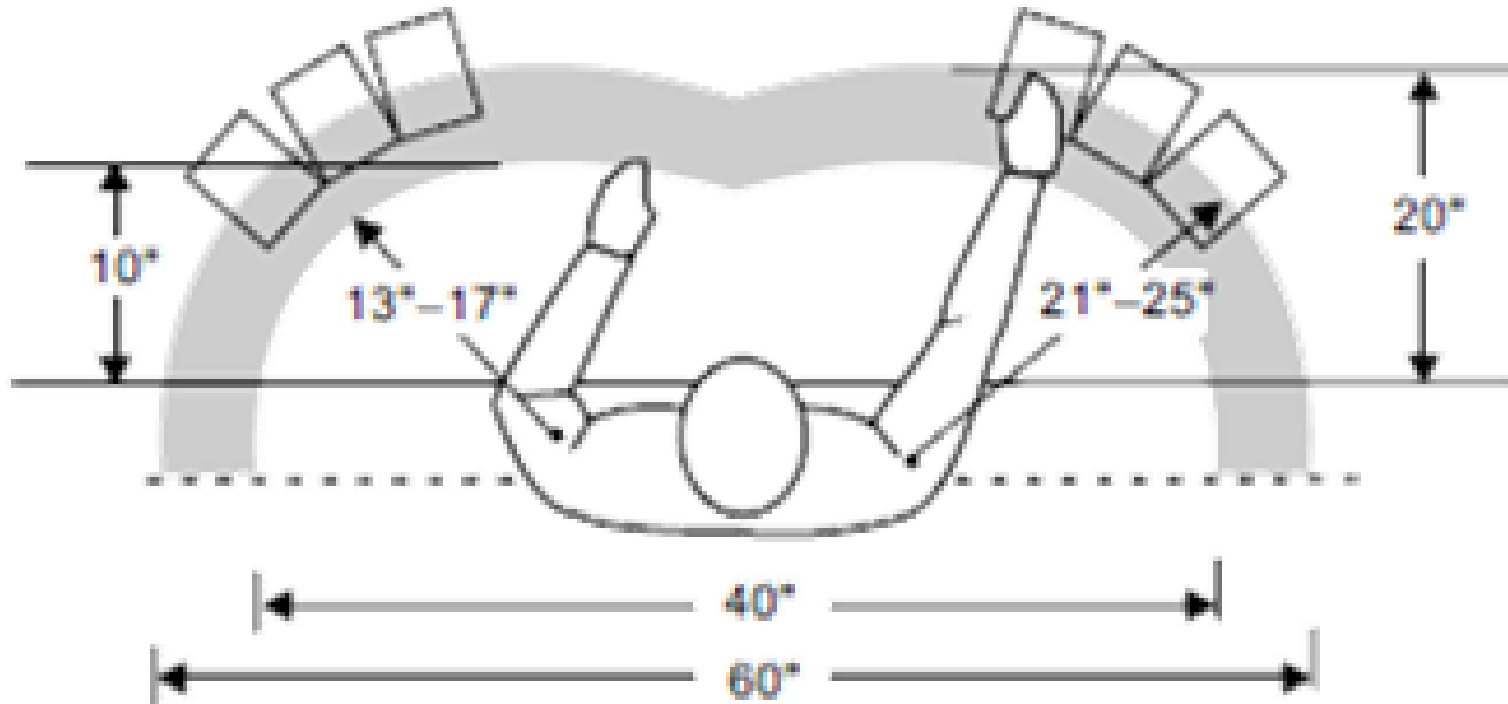


\*Adapted in part from Grandjean E [1982] (*Fitting the Task to the Man: An Ergonomic Approach*. London: Taylor & Francis Ltd.) and UAW-GM [1990] (*UAW-GM Ergonomics Handbook*. Madison Heights, Michigan: Center for Health & Safety).



# Evaluating Job Risk Factors: Seated Work

- Recommended Workstation Measurements



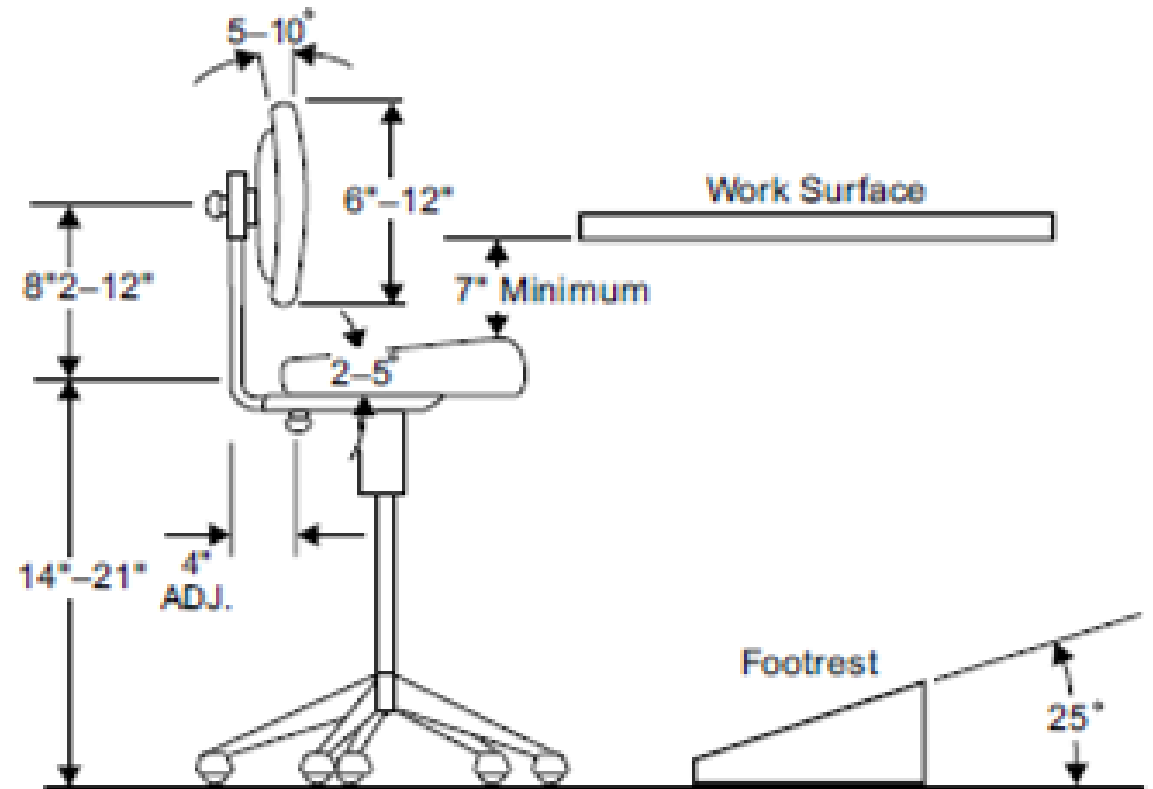
## SEATED WORK:

Primary  and secondary  areas for table top work.



# Evaluating Job Risk Factors: Seated Work

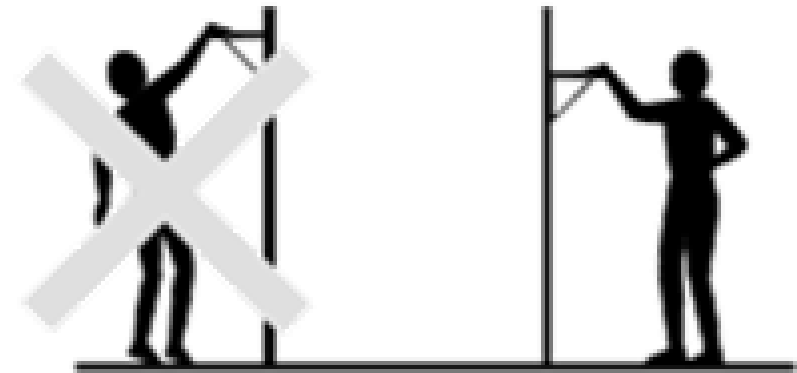
- Precision work = 31-37 in
- Reading/writing = 28-31 in
- Typing/ light assembly = 21-28 in
- Seat and back rest heights should be adjustable as noted



# Evaluating Job Risk Factors: Standing Work



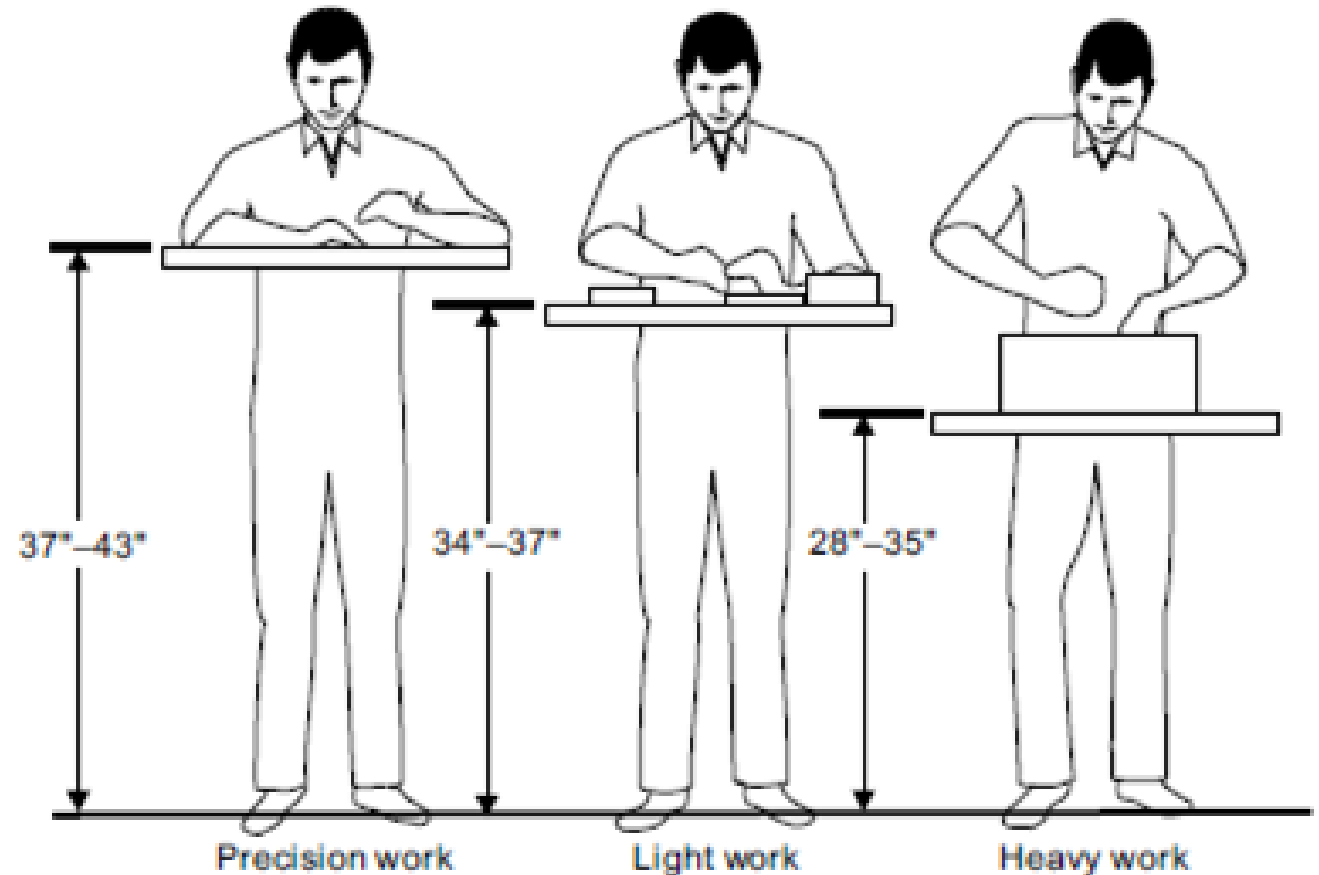
- Self heights:
  - Free-standing person can reach
  - Place hand flat on shelf
  - Should NOT exceed **60 in.**



# Evaluating Job Risk Factors: Standing Work



- Precision work –
  - above elbow height
- Light work –
  - just below elbow height
- Heavy work –
  - 4-6 in. below elbow height



# Prevent Risk: Choose Appropriate Tools



- Ensure at least good quality tools are provided for each task
- When fit is to be considered assure tools fit the user
- Repair / replace damaged tools promptly





## An Ounce of Prevention

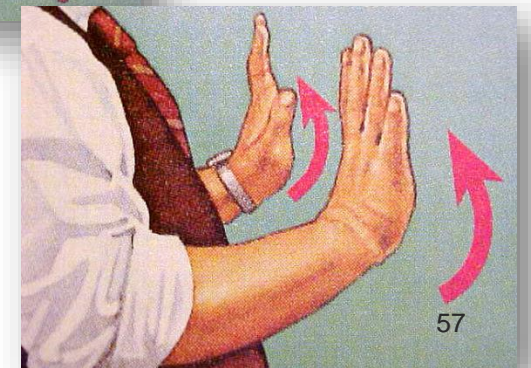
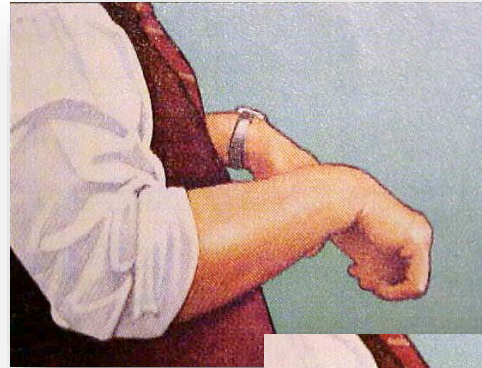
1. Warm up & stretch before activities that are repetitive, static or prolonged
2. Take *frequent breaks* from ANY sustained posture every 20-30 minutes
3. Respect pain- positions or stop painful activity
4. Recognize early signs of inflammatory process, & tx early





# Exercise the Hand and Wrist

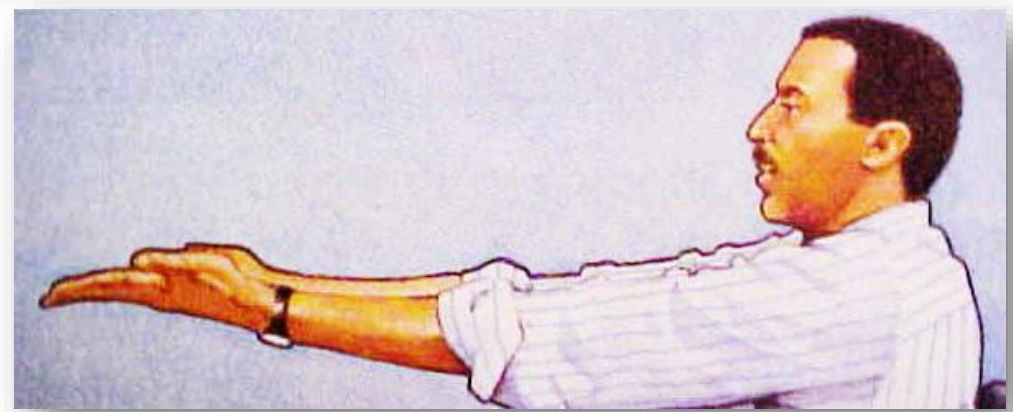
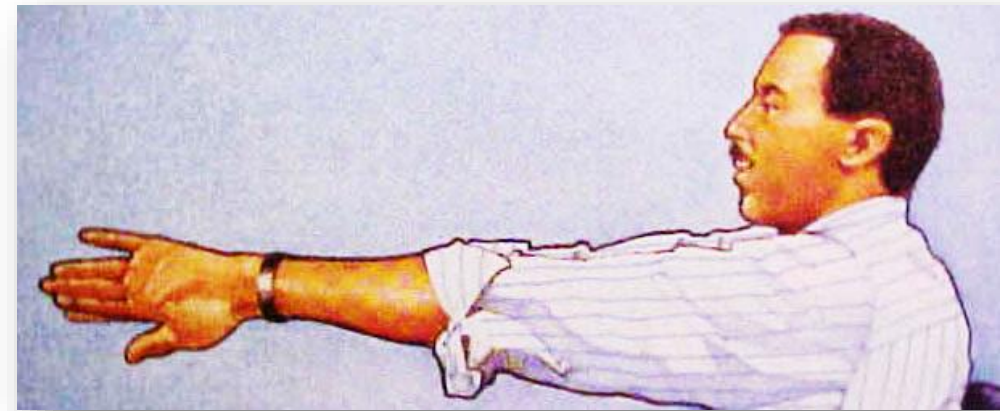
- gentle fists
- straighten fingers toward floor
- stretch lower arms
- point fingers up
- hold
- repeat 3 times





# [ Exercise the Arms

- arms straight out
- rotate so backs of hands touch
- hold
- rotate palms up
- hold
- relax
- repeat 3 times





# Exercise the Fingers

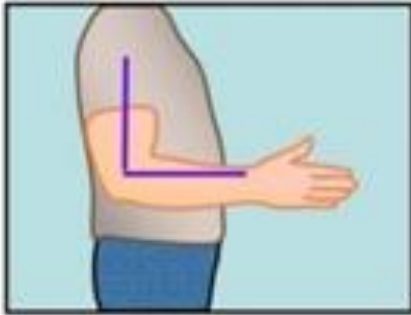


- sit or stand
- drop arms to side
- gently shake arms, hands and fingers
- relax
- repeat 3 times



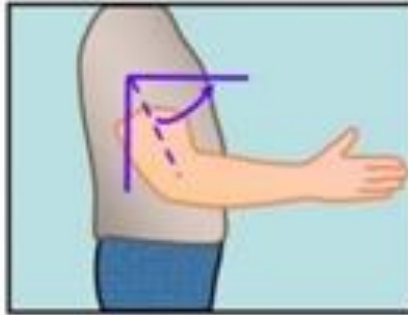
# Maintain Neutral Posture

## Neutral Posture

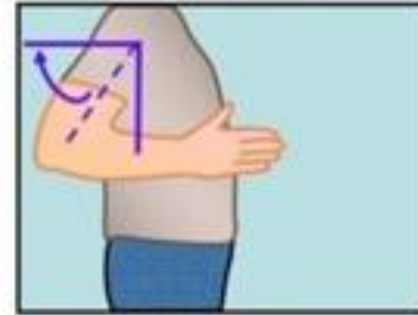


## Awkward Postures

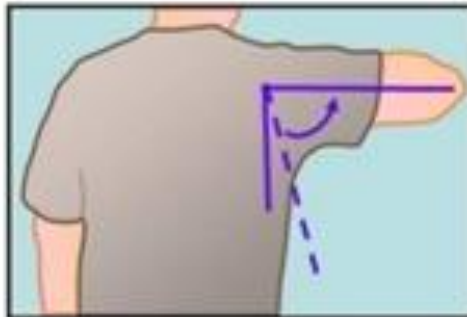
### Shoulder Flexion



### Shoulder Extension



### Shoulder Abduction

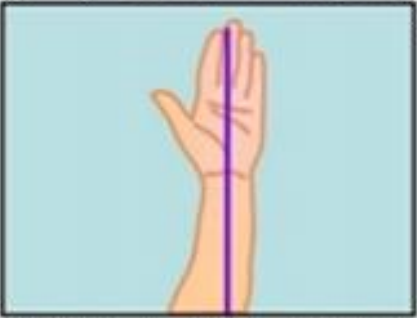

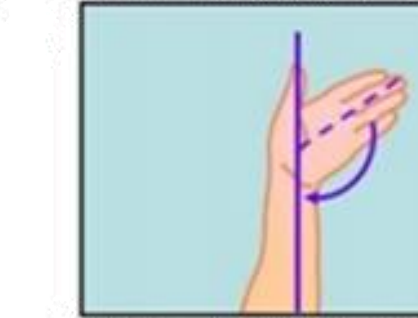
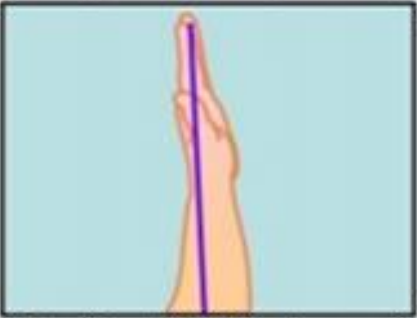
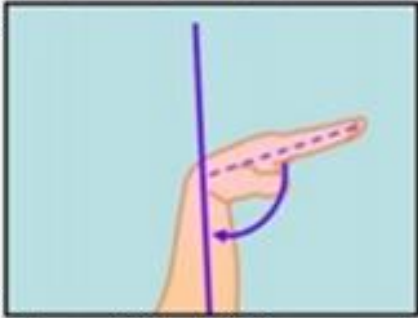
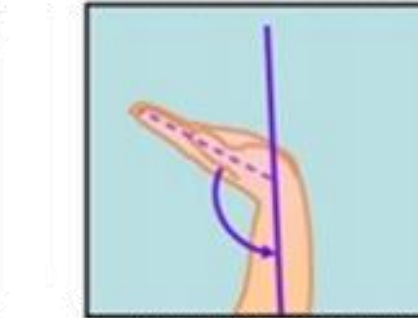


### Shoulder Abduction & Extension





# Maintain Neutral Posture

<u>Neutral Posture</u>	<u>Awkward Postures</u>	
<p data-bbox="417 439 853 511">View#1 (minimal radial/ulnar deviation)</p> 	<p data-bbox="922 475 1337 511">Radial Deviation</p> 	<p data-bbox="1368 475 1783 511">Ulnar Deviation</p> 
<p data-bbox="417 928 853 999">View#2 (minimal flexion/extension)</p> 	<p data-bbox="922 968 1337 1003">Flexion</p> 	<p data-bbox="1368 968 1783 1003">Extension</p> 

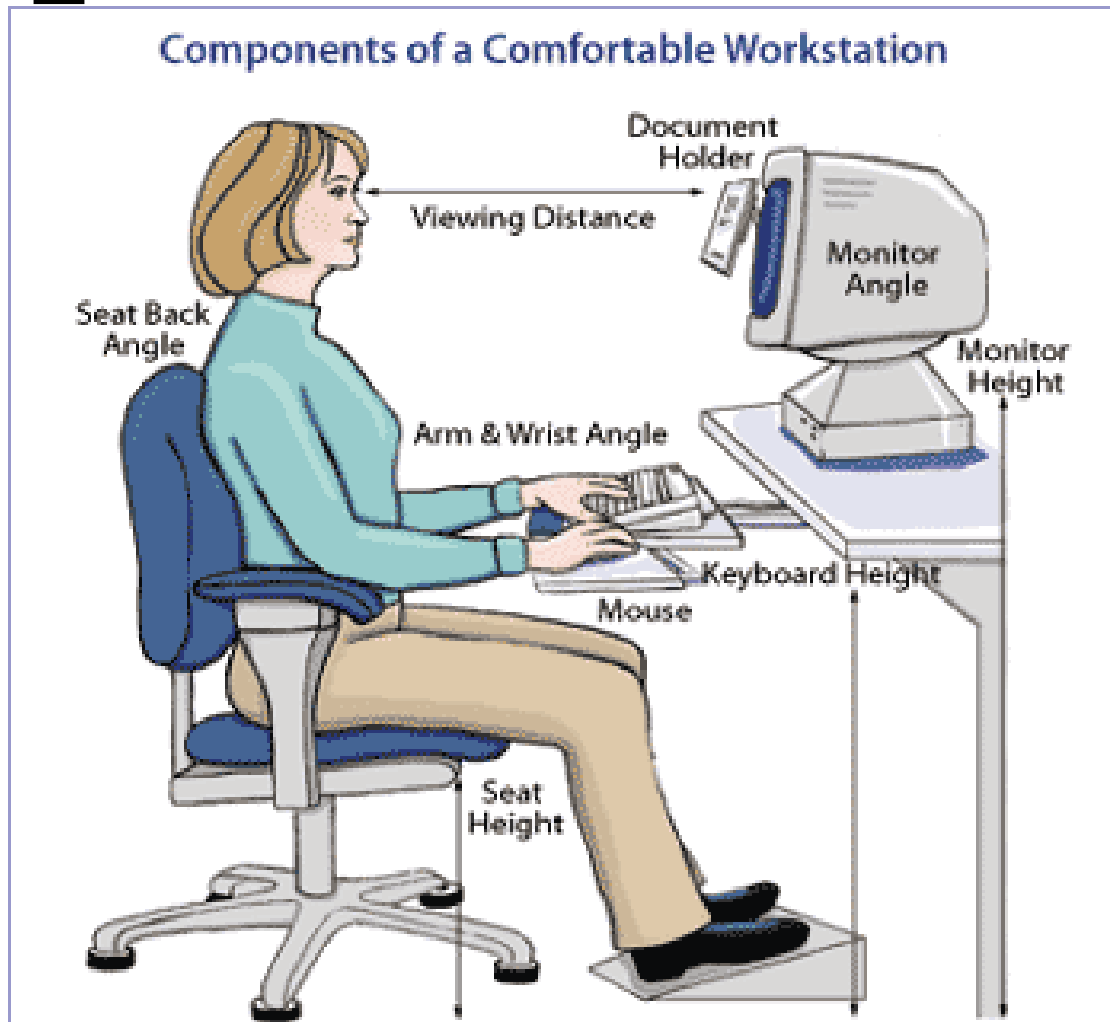


# Sit Right





# Points to Remember



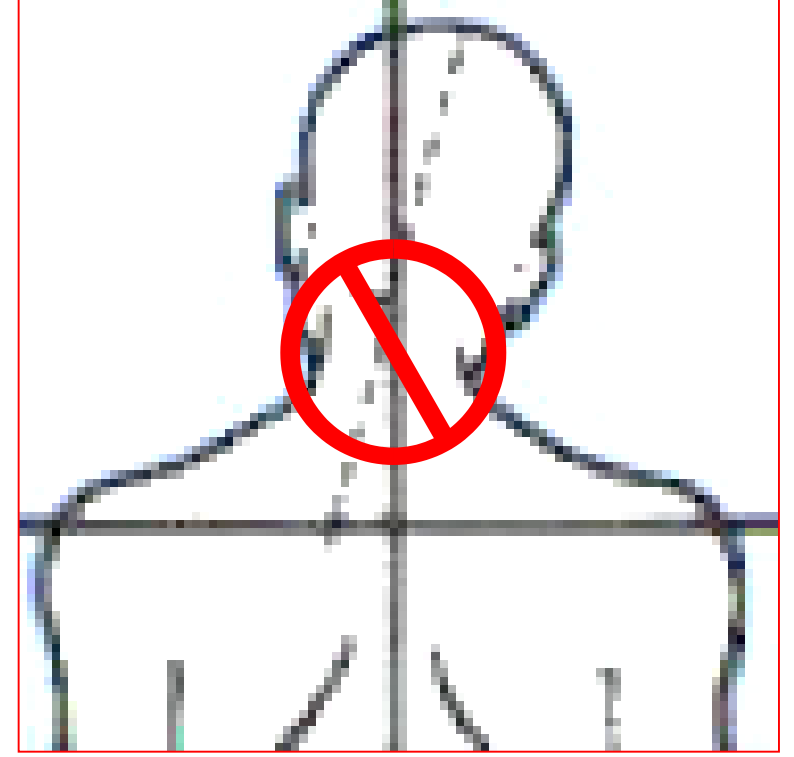
- Position equipment & work directly in front of and close to your major tasks
- Keep upper arms close to the body, elbows 90-100 degrees
- Keep feet flat on floor, upper body weight resting on “sits bones”
- Wrists as neutral as possible; safe zone for wrist movement is 15 degrees in all directions
- Avoid bending neck forward for prolonged periods of time (\*remember *quadruple* the force); use a copy holder



# [ To Tilt or Not to *TILT*



Negative tilt allows the wrist to be in neutral position



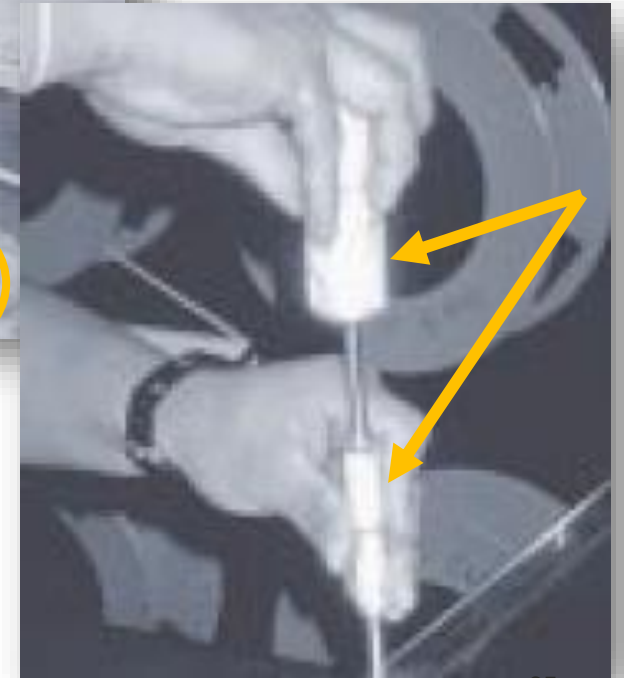




## CLUES to watch for:

Are workers?

- Modifying their tools, equipment or work area
- Shaking their arms and hands
- Rolling their shoulders
- Bringing products such as back belts or wrist braces into the workplace



[ WWOS ? ]



# What would OSHA<sup>®</sup> say? Occupational Safety and Health Administration

## OSHA's Role in Hand Protection

**Addressed in OSHA Regulation  
29 CFR 1910.138 – Hand  
protection**

# Other OSHA Regulations Related to Hand Safety



Hand and Portable Powered Tools and Equipment (29 CFR 1910.242)



Control of Hazardous Energy – Lockout/Tagout (29 CFR 1910.147)



Machinery and Machine Guarding (29 CFR 1910 Subpart O)



## Hand and Power Tools



-  Home
- OSHA Standards >
- Hazards and Solutions >
- Additional Resources >

### OSHA Standards

This section highlights OSHA standards, directives (instruction to OSHA staff), and letters of interpretation (official letters of interpretation of the standards) related to hand and power tools in the workplace.

#### General Industry (29 CFR 1910)

- [1910 Subpart P](#), Hand and portable powered tools and other hand-held equipment
  - [1910.241](#), Definitions
  - [1910.242](#), Hand and portable powered tools and equipment, general
  - [1910.243](#), Guarding of portable powered tools
  - [1910.244](#), Other portable tools and equipment
- [1910 Subpart R](#), Special industries
  - [1910.266](#), Logging operations [[related topic page](#)]
- [1910 Subpart T](#), Commercial diving operations [[related topic page](#)]
  - [1910.422](#), Procedures during dive

#### Shipyard Employment (29 CFR 1915)

- [1915 Subpart H](#), Tools and related equipment
  - [1915.131](#), General precautions
  - [1915.132](#), Portable electric tools
  - [1915.133](#), Hand tools
  - [1915.134](#), Abrasive wheels
  - [1915.135](#), Powder actuated fastening tools
  - [1915.136](#), Internal combustion engines, other than ship's equipment

#### Marine Terminals (29 CFR 1917)

- [1917 Subpart C](#), Cargo handling gear and equipment
  - [1917.61](#), Hand tools

#### Longshoring (29 CFR 1918)

- [1918 Subpart G](#), Cargo handling gear and equipment other than ship's gear
  - [1918.69](#), Tools

#### Construction Industry (29 CFR 1926)

- [1926 Subpart I](#), Tools - hand and power
  - [1926.300](#), General requirements
  - [1926.301](#), Hand tools
  - [1926.302](#), Power-operated hand tools
  - [1926.303](#), Abrasive wheels and tools
  - [1926.304](#), Woodworking tools
  - [1926.305](#), Jacks-lever and ratchet, screw, and hydraulic
  - [1926.306](#), Air receivers
  - [1926.307](#), Mechanical power-transmission apparatus

Directives

**State Standards**

There are twenty-eight [OSHA-approved State Plans](#), operating state-wide occupational safety and health programs. State Plans are required to have standards and enforcement programs that are at least as effective as OSHA's and may have different or more stringent requirements.



# OSHA Standards:

<https://www.osha.gov/SLTC/handpowertools/standards.html>

# To Review?



ILLOS: CARTOONS <http://www.bertographics.com/xybix.html>

- ✓ carpal tunnel syndrome is
- ✓ possible causes of carpal tunnel
- ✓ repetitive motion and cumulative trauma
- ✓ predisposing factors
- ✓ symptoms of carpal tunnel
- ✓ treatment options
- ✓ post-op expectations
- ✓ ergonomic principles
- ✓ WWOS ?



# THANK YOU



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Wesleyan  
UNIVERSITY

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# In the Corporate/Industrial Setting Athletic Trainers:



- possess confidant evaluation skills, and an understanding of orthopedic protocols for acute, chronic and post surgical rehabilitation.
- perform an ergonomic assessment of both static and dynamic activities, establish functional capacity exam standards
- fit employees with proper personal protective equipment (PPE),
- develop a line of communication when dealing with an employee incident
- develop and record an accurate assessment of job duties & instruct employees in proper task performance
- understand established safety issues and OSHA guidelines
- professionally research topics, create a presentation and present material to pertinent parties

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