

# Vibration & Ergonomics

Safety and Health at Work and Home



# What is Ergonomics?

- Ergonomics is the process of finding ways to help people work more efficiently and injury free in their environment

## What is vibration?

- A continuous, slight shaking movement. A series of small, fast back-and-forth or side to side movements.



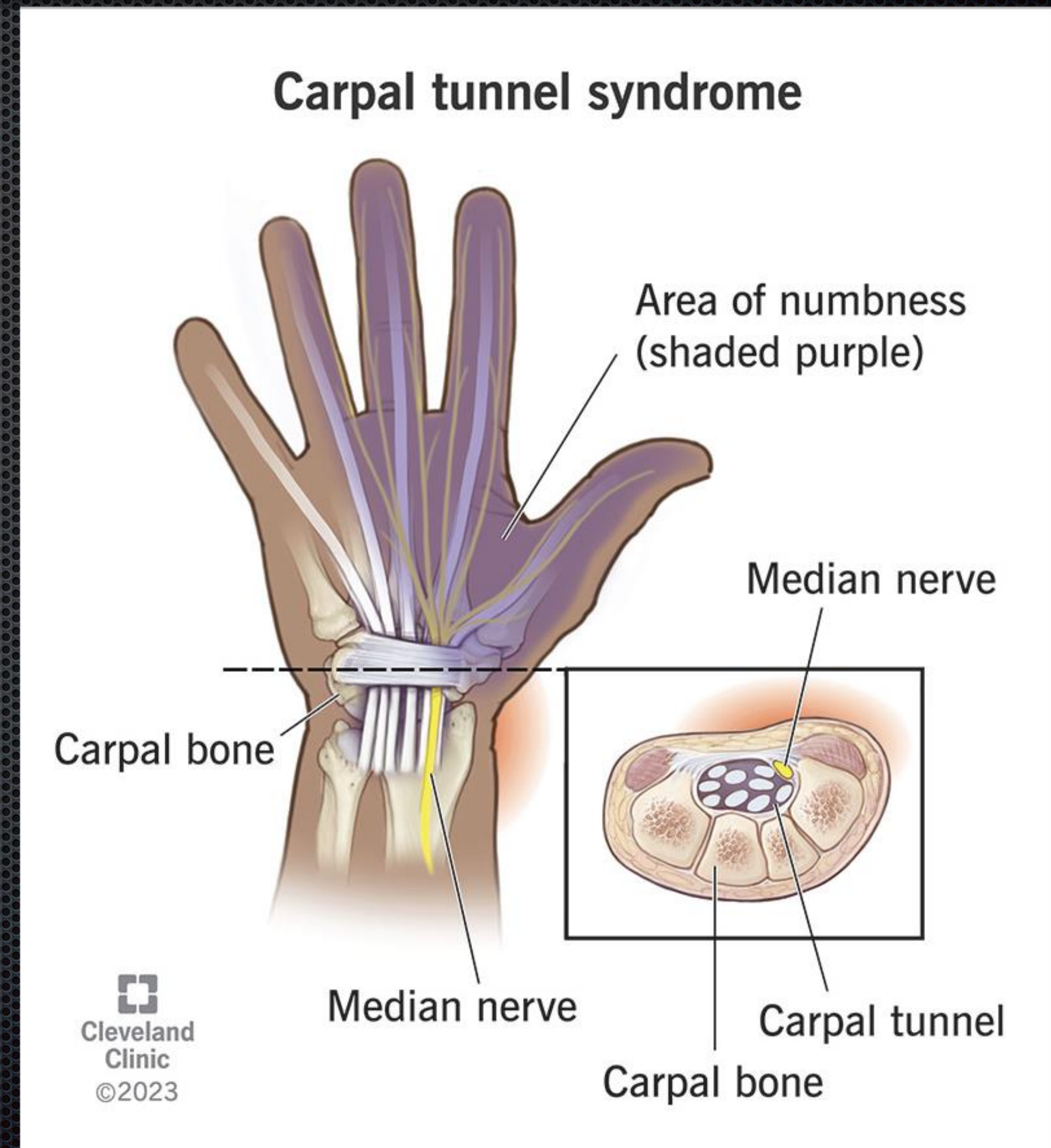
# Types of Vibration Exposures

- Whole Body Vibration - Agriculture, Aviation, Construction & Mining, Manufacturing and Transportation
- Hand Arm Vibration - Automotive & Engineering, Landscaping & Gardening, Construction & Manufacturing
- Crossover Exposures - an example would be if a worker lets a tool rest against the body to try and reduce the vibration. It causes whole body vibration, as well as hand arm vibration.



# Effects of Hand and Arm Vibration

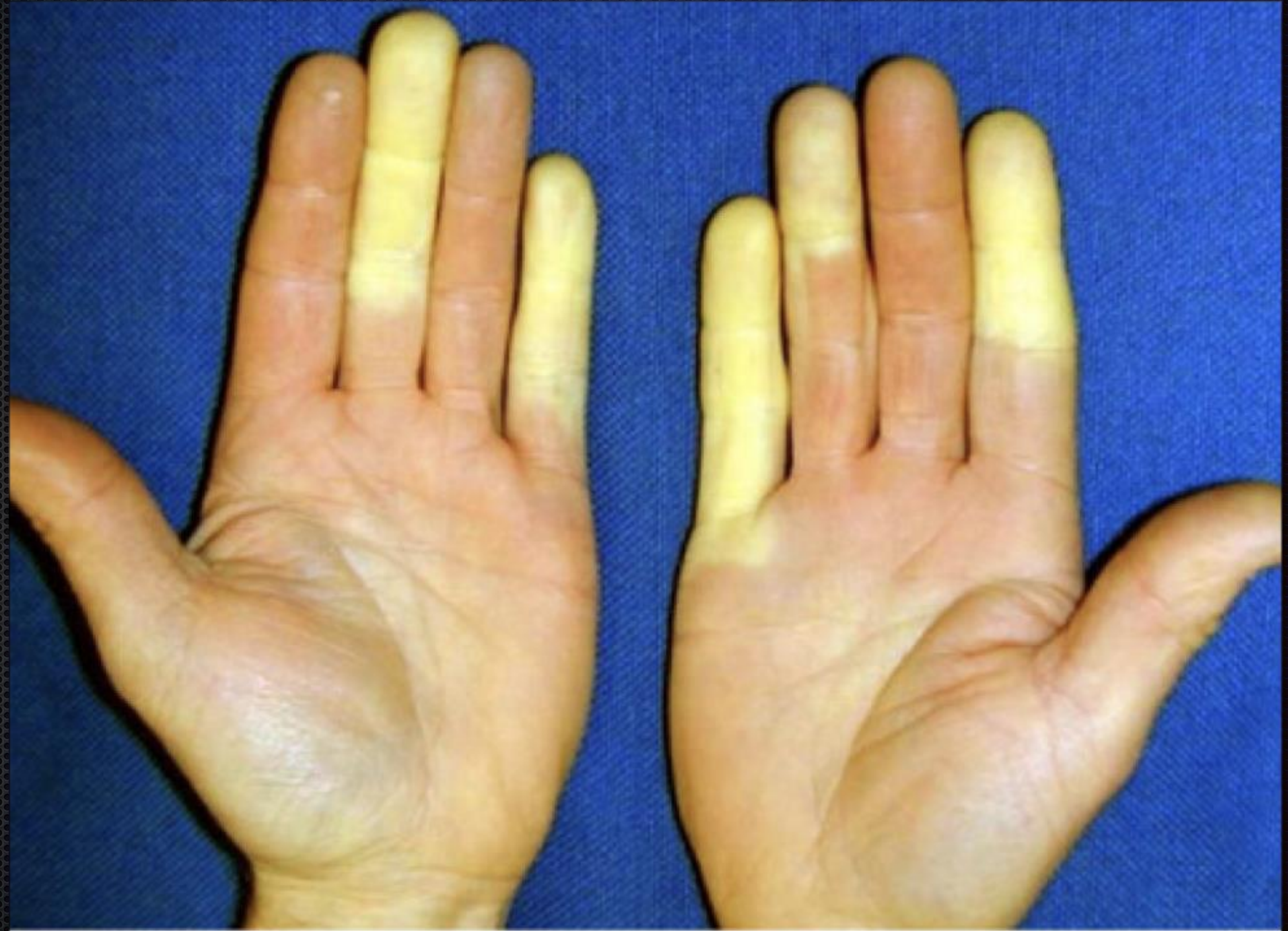
- Hand Arm Vibration Syndrome (HAVS)
- Carpal Tunnel Syndrome
- Raynaud's Phenomenon or White Finger





# White Finger

- Due to nerve and blood vessel damage
- Numbness & Tingling
- Color change in cold or wet conditions
- Loss of strength









# Effects of Whole Body Vibration

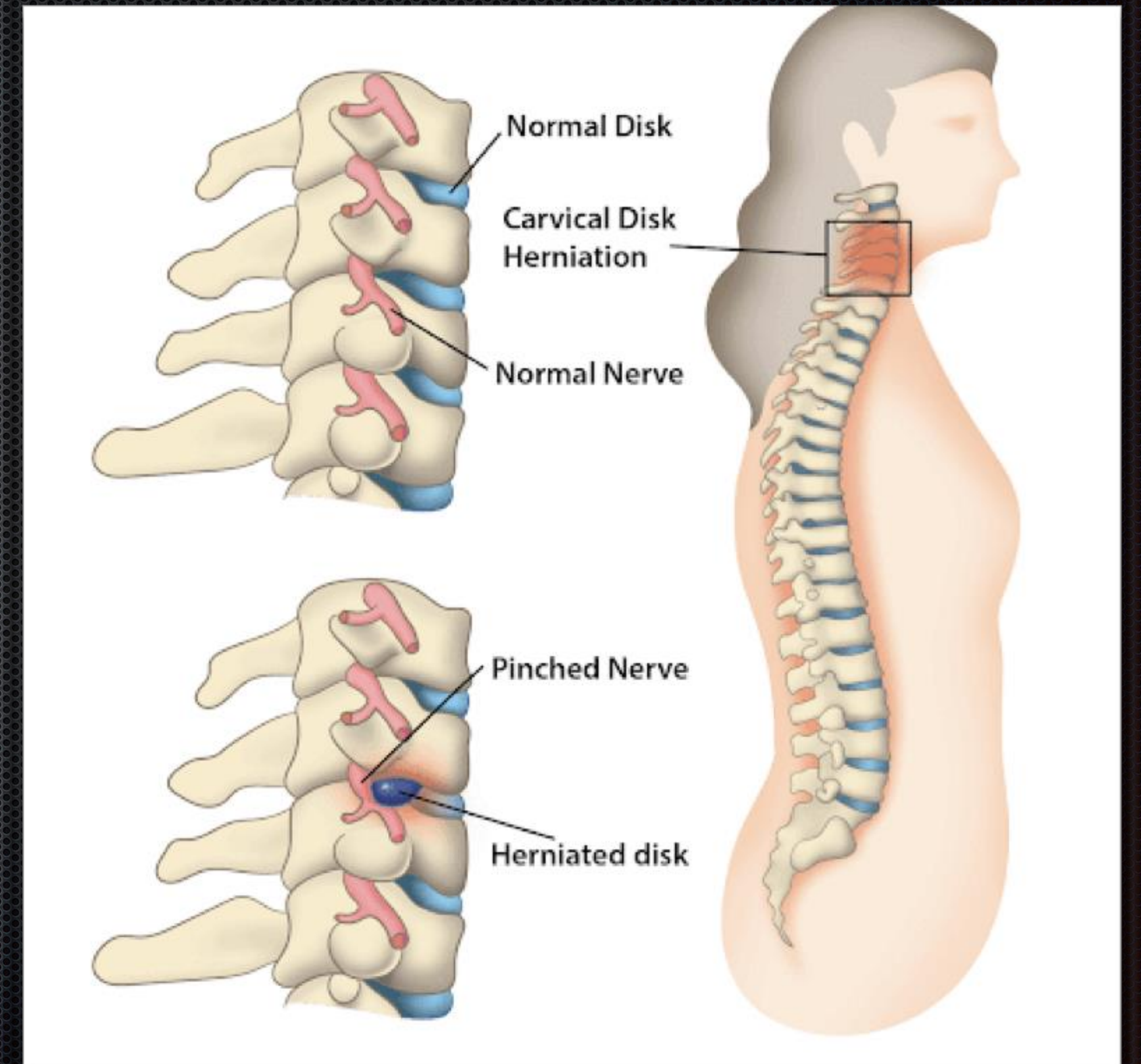
- Musculoskeletal Disorders - back and joint pain
- Circulatory Issues - reduce grip strength and affect blood circulation
- Digestive Problems - stomach ulcers & IBS





# Musculoskeletal Disorders

- Neck & Back Pain
- Ligament & Muscle Injuries & Strains
- Pinched Nerves
- Herniated Discs







Golden Gate Bridge



Empire State Building



Panama Canal



Table 1

Epidemiologic studies of vibration and musculoskeletal disorders of the neck and shoulder

| Author                      | Study design    | Industry or occupation                                                                                                                            | Sample                                                                                              | Exposure(s)                                                                                                                                                           | Outcome(s)                                                                | Results and comments                                                                                                                                                                                                                  |
|-----------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Engholm and Holmstrom, 2005 | Cross-sectional | Sweden: construction workers                                                                                                                      | 85,191 men                                                                                          | Vibration exposure                                                                                                                                                    | Neck and shoulder disorders                                               | Neck and shoulder disorders were significantly associated with vibration exposure.                                                                                                                                                    |
| Grooten et al, 2007         | Longitudinal    | Sweden: workers in various occupations                                                                                                            | 803 men and women (77% response rate)                                                               | Working with vibrating tools; sitting ≥75% of working time                                                                                                            | Incidence of self-reported neck and shoulder pain at the end of follow-up | Simultaneous exposure to ≥2 of the following: (1) manual handling, (2) working with hands above shoulder level, and (3) working with vibrating tools is associated with a lower chance of being symptom free at the end of the study. |
| Hagberg et al, 2006         | Cross-sectional | Sweden: workers in various occupations (e.g., agriculture, forestry, fishery, plant & machinery)                                                  | 9,798 men and women (70% response rate)                                                             | WBV                                                                                                                                                                   | MSDs in neck, shoulder/arm, and hand                                      | Exposure to WBV (≥50% working time) was associated with increased prevalence of MSDs in neck, shoulder/arm, and hand.                                                                                                                 |
| Issever et al, 2003         | Case–control    | Turkey: rock drill workers, heavy-vehicle operators, and office workers                                                                           | 114 workers (50 rock drill workers and 64 heavy-vehicle operators) and 54 controls (office workers) | HTV and WBV                                                                                                                                                           | Variety of health complaints including shoulder pain                      | Compared with controls, rock-drilling operators (HAV exposure) had significantly more shoulder pain when holding arms up.                                                                                                             |
| Johanning et al, 2004       | Case–control    | USA: railroad engineers (men and women)                                                                                                           | 1,195 engineers (47% response rate) and 323 controls (41% response rate)                            | WBV                                                                                                                                                                   | Neck and shoulder pain                                                    | Compared with the control group, a significantly greater proportion of railroad engineers who are exposed to WBV reported severe neck and shoulder pain in the past year (OR = 1.86, 95% CI = 1.06–3.28).                             |
| Merlino et al, 2003         | Cross-sectional | USA: apprentice construction workers                                                                                                              | 996 men and women (84.8% response rate)                                                             | Occupational exposures associated with construction (e.g., repetitive tasks, working in cramped positions, awkward posture, grasp small objects, bending or twisting) | MSDs of neck, shoulder, upper and lower limbs                             | Most apprentice construction workers reported MSD symptoms in at least one of nine anatomical sites during the previous year. Women reported significantly more MSD symptoms in the neck, shoulder, and a few other regions than men. |
| Miyashita et al, 1992       | Cross-sectional | Japan: construction machinery operators (power shovel operators, bulldozer operators, forklift operators) and office workers                      | 184 power shovel operators, 127 bulldozer operators, 44 forklift operators, and 44 controls         | WBV and local vibration                                                                                                                                               | Stiff shoulder, and low back pain                                         | WBV was associated with stiff shoulder (43.5–56.8%) in operators. No significant differences were found in the upper limbs between operators and controls.                                                                            |
| Palmer et al, 2001a         | Cross-sectional | England: manual occupations (e.g., carpenters, fitters, construction workers, motor mechanics, electricians, welders, gardeners) and armed forces | 1,856 men                                                                                           | HTV                                                                                                                                                                   | MSDs of upper limbs, neck, shoulder                                       | Prevalence of pain in the past week: Neck: PR = 1.8 (1.4–2.3) Shoulder: PR = 1.9 (1.4–2.4). There was a significant association between dose of HTV and recent pain in upper limbs and neck.                                          |
| Palmer et al, 2001b         | Cross-sectional | UK: workers in several industries (blue-collar and white-collar workers, and the armed forces)                                                    | 12,907 men and women (61% response rate)                                                            | HAV and WBV                                                                                                                                                           | MSDs of upper and lower limbs, neck, shoulder                             | 4,348 workers (34%) reported neck pain in the past year. Neck pain was most prevalent among male construction workers (38%). No associations were found with exposure to vibration                                                    |



| Author                         | Study design    | Industry or occupation                                                           | Sample                                                           | Exposure(s)                                                                                                                    | Outcome(s)                                                     | Results and comments                                                                                                                                                            |
|--------------------------------|-----------------|----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gangopadhyay et al, 2010       | Cross-sectional | India: male workers in carbon dioxide and chemical sand core –making operations  | 50 men                                                           | Awkward posture                                                                                                                | MSDs of the shoulder, neck, and other regions                  | Awkward posture was significantly associated with MSDs of the shoulder, neck, and other regions.                                                                                |
| Ghasemkhani et al, 2008        | Cross-sectional | Iran: workers manufacturing hygienic products                                    | 75 workers                                                       | Repetitive movements and awkward posture                                                                                       | MSDs of the neck and shoulders                                 | Repetitive movements with awkward posture were significantly associated with MSDs.                                                                                              |
| Ghosh et al, 2010              | Cross-sectional | India: male goldsmiths                                                           | 120 men                                                          | Awkward posture and repetitiveness                                                                                             | MSDs of the neck, shoulder, lower back, and wrists.            | Awkward posture associated with MSDs especially those of the neck and low back.                                                                                                 |
| Grzywacz et al, 2012           | Cross-sectional | US: Latino immigrant workers in the poultry industry                             | 138 men and 138 women each in poultry and nonpoultry work groups | Awkward posture and repeated movements, heavy load, psychological demands, and abusive supervision                             | Epicondylitis, rotator cuff syndrome, and back pain            | Awkward posture and repeated movements were associated with epicondylitis, rotator cuff syndrome, and back pain.                                                                |
| Hanklang et al, 2014           | Cross-sectional | Thailand: female workers using hand-operated rebar benders                       | 272 women                                                        | Awkward posture, repetitive movements, prolonged working hours, bending of neck or trunk, stooping, and psychosocial factors   | MSDs of the neck and shoulders                                 | Workers with prolonged working hours and awkward posture were more likely (43.8 times) to develop MSDs.                                                                         |
| Herin et al, 2012              | Longitudinal    | France: workers in various industries                                            | 1990: 21,378 and 1995: 18,695, men and women                     | Physical factors: forceful effort, effort with tools, heavy loads, movements, posture, and vibration and psychological factors | Shoulder pain                                                  | Forceful effort and awkward posture were predictive of chronic shoulder pain at 5 years; the most robust predictor was awkward posture. Decision control was also a predictor.  |
| Kaminskas and Antanaitis, 2010 | Cross-sectional | Lithuania: construction workers                                                  | 276 (62.7% response rate)                                        | Awkward work posture, and high use of physical force                                                                           | Pain and discomfort in the neck, shoulders, and other regions. | Awkward work posture and high use of physical force were significantly associated with pain and discomfort in the neck, shoulder, and other regions.                            |
| Lemasters et al, 1998          | Cross-sectional | USA: carpenters (e.g., drywall, ceiling, framing, building concrete forms, etc.) | 522 (97.8% men) (83% response rate)                              | Repetitiveness, awkward posture, exhaustion, and psychosocial issues                                                           | MSDs of shoulders, and upper and lower extremities.            | Psychosocial issues associated with MSDs of the shoulder, etc. MSDs of upper extremities are most prevalent among all carpenters, particularly drywall and ceiling installers.  |
| Miranda et al, 2004            | Longitudinal    | Finland: workers in the forestry industry                                        | 2094 women and men                                               | Working with trunk forward flexed, with hand above shoulders, and physical work with a heavy load                              | Shoulder pain                                                  | Working with trunk forward flexed, with hand above shoulders, physical work with a heavy load increased the risk of incident shoulder pain.                                     |
| Miranda et al, 2008            | Longitudinal    | Finland: workers in various industries                                           | 883 women and men                                                | Repetitive movements, vibration, awkward posture, lifting heavy loads, and psychosocial factors                                | Shoulder MSDs                                                  | 63 incident cases of shoulder MSDs. <i>Men</i> : vibration and repetitive movements. <i>Women</i> : lifting heavy loads and awkward posture significantly associated with MSDs. |
| Nag et al, 2012                | Cross-sectional | India: workers in fish-processing industry                                       | 450 women                                                        | High levels of physical activity, cold environment, poor task clarity, and manual material handling                            | Pain and discomfort in neck and shoulders.                     | High levels of physical activity, cold environment, poor task clarity, and manual material handling were associated with pain and discomfort in the neck and shoulder.          |



# How to Prevent Injury From Vibration

- Use low vibration tools and equipment
- Design workstations with ergonomics in mind
- Rotate workers between tasks and provide breaks
- Calibrate tooling to monitor vibration levels
- Use proper PPE, such as anti-vibration gloves
- Provide training, so that workers recognize vibration related injuries, proper tool usage and body positioning
- Encourage prompt reporting of symptoms or discomfort related to vibration exposure

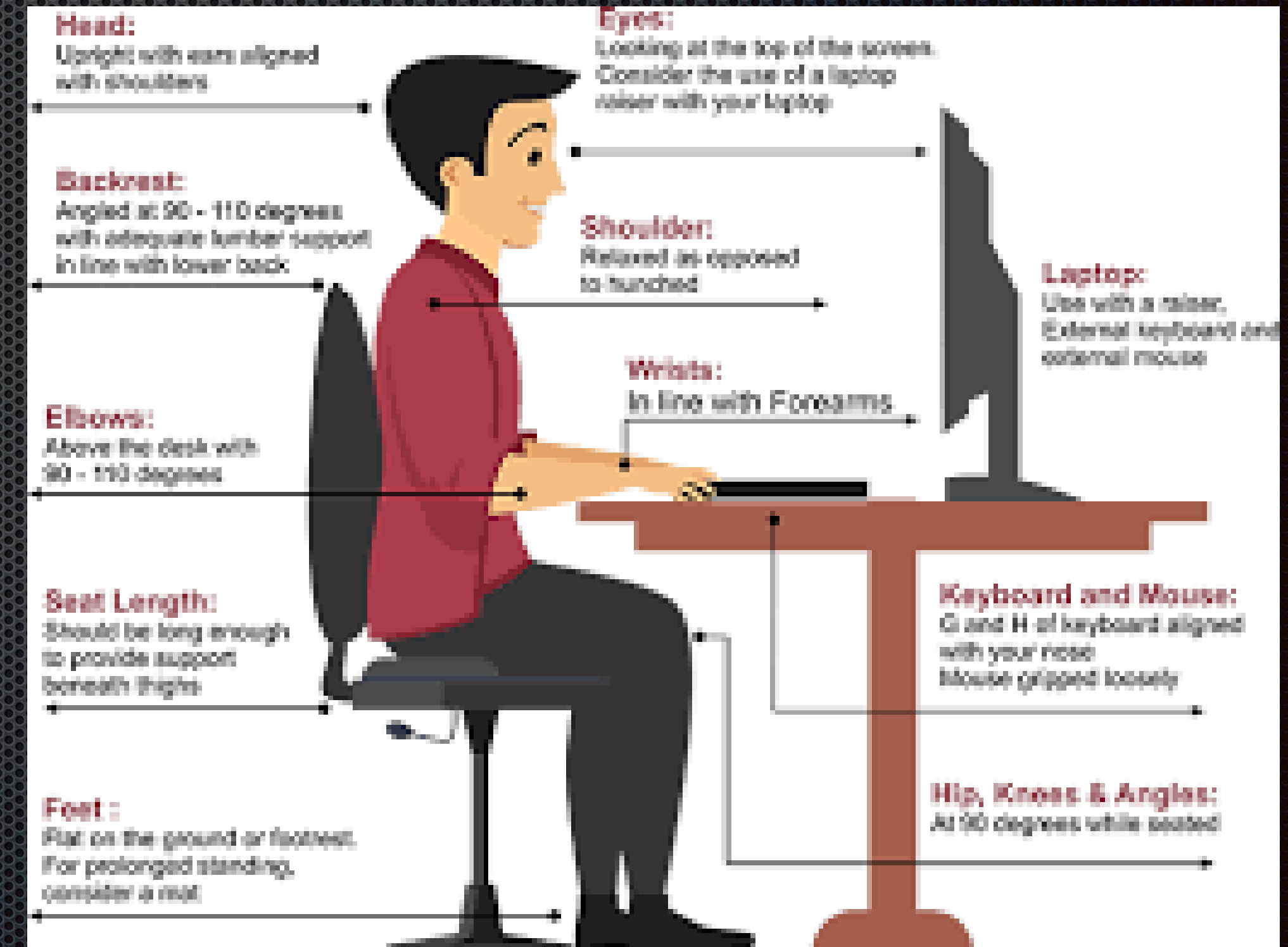




Impact gloves



“Hogue” rubber grip



Proper Computer Workstation Ergonomics



# Ergonomic Guide for Selecting Tools

- Tool Weight
- Handle Diameter, Size & Shape
- Tool Length
- Tool Material





# Helpful Links

- <https://www.osha.gov/ergonomics>
- [www.mcclureergonomics.com/hand-vibration-ergonomics/](http://www.mcclureergonomics.com/hand-vibration-ergonomics/)
- [www.academic.oup.com/annweh/article/66/1/69/6377934](http://www.academic.oup.com/annweh/article/66/1/69/6377934)
- <https://www.cdc.gov/niosh/ergonomics/index.html>
- [www.mayoclinic.org/healthy-lifestyle/adult-health/in-depth/office-ergonomics/art-20046169](http://www.mayoclinic.org/healthy-lifestyle/adult-health/in-depth/office-ergonomics/art-20046169)
- [www.ehs.unc.edu/topics/ergonomics/](http://www.ehs.unc.edu/topics/ergonomics/)



# Contact Information

Lenny Dorosh  
Chief ESH Steward  
Teamsters Local 1150  
Sikorsky Aircraft  
[lenny.c.dorosh@lmco.com](mailto:lenny.c.dorosh@lmco.com)  
Cell 475-298-9941  
Work 203-386-2195

