UE INJURIES: HAND, ARM & WRIST

Pamela Rast, PhD, LAT, ATC

Professor of Athletic Training

Director of Athletic Training Education

Texas Wesleyan University

Fort Worth, Texas

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.

NATIONAL ATHLETIC TRAINERS' ASSOCIATION
HEALTH CARE FOR LIFE & SPORT

What we will cover today

- Types of Trauma & Related Risks
- Lacerations
- Tendon injuries
- Contributing workplace characteristics
- Claim review considerations
- OSHA Role in injury prevention

Types of Trauma

- Repetitive Motion Injuries (RMIs) /Disorders (MDs)
  - Cumulative Trauma Disorders (CTDs)
  - Repetitive Stress Injuries (RSIs)
- Acute Trauma
  - Fracture, sprain, dislocation, strain, laceration
- Blunt Trauma

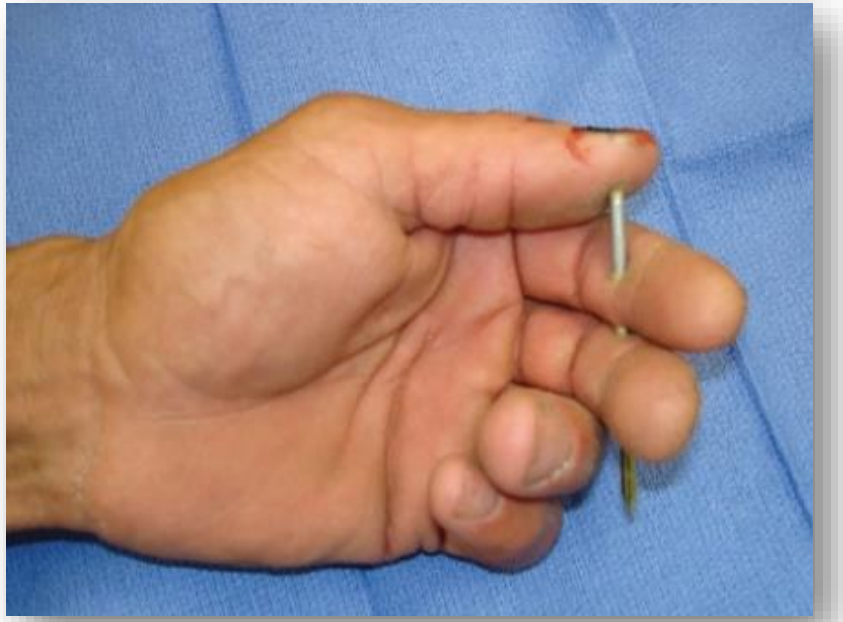
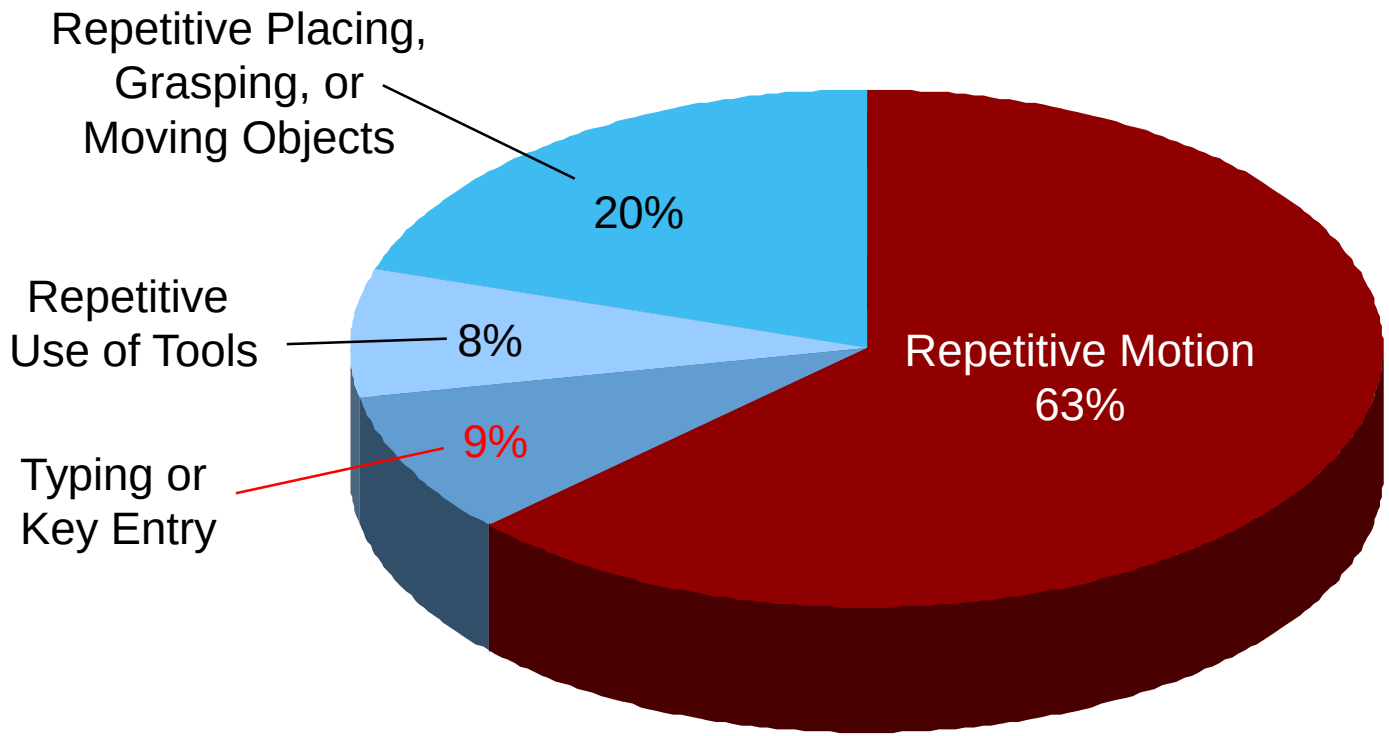


Image Source: Pierpont, et al (2008)

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

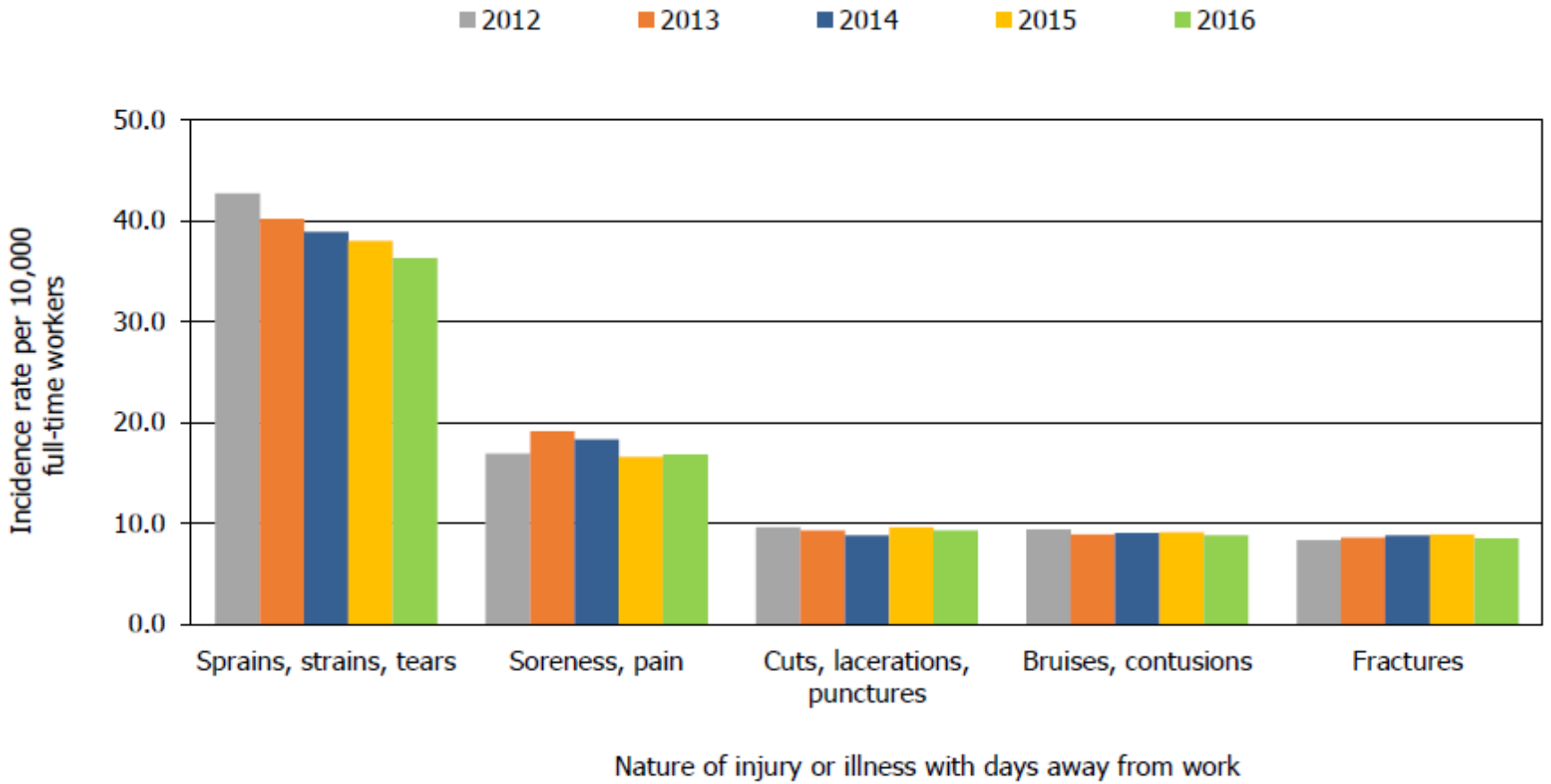
- More than 90 % of all office workers use a computer work station
- In 2014 MSDs accounted for 32% injury and illness cases
- Incidence rate decreased to 33.8 cases per 10,000 f-t workers (2013 it was 35.8 cases)
- Nursing assistants had highest number of cases (54% of total cases) in 2014

Definitions

- Tendon → muscle to bone
- Ligament → bone to bone
- Sprain → ligament injury
- Strain → muscle injury
- Laxity → joint translation
- Subluxation → pathologic laxity
- Dislocation → no contact of joint surfaces

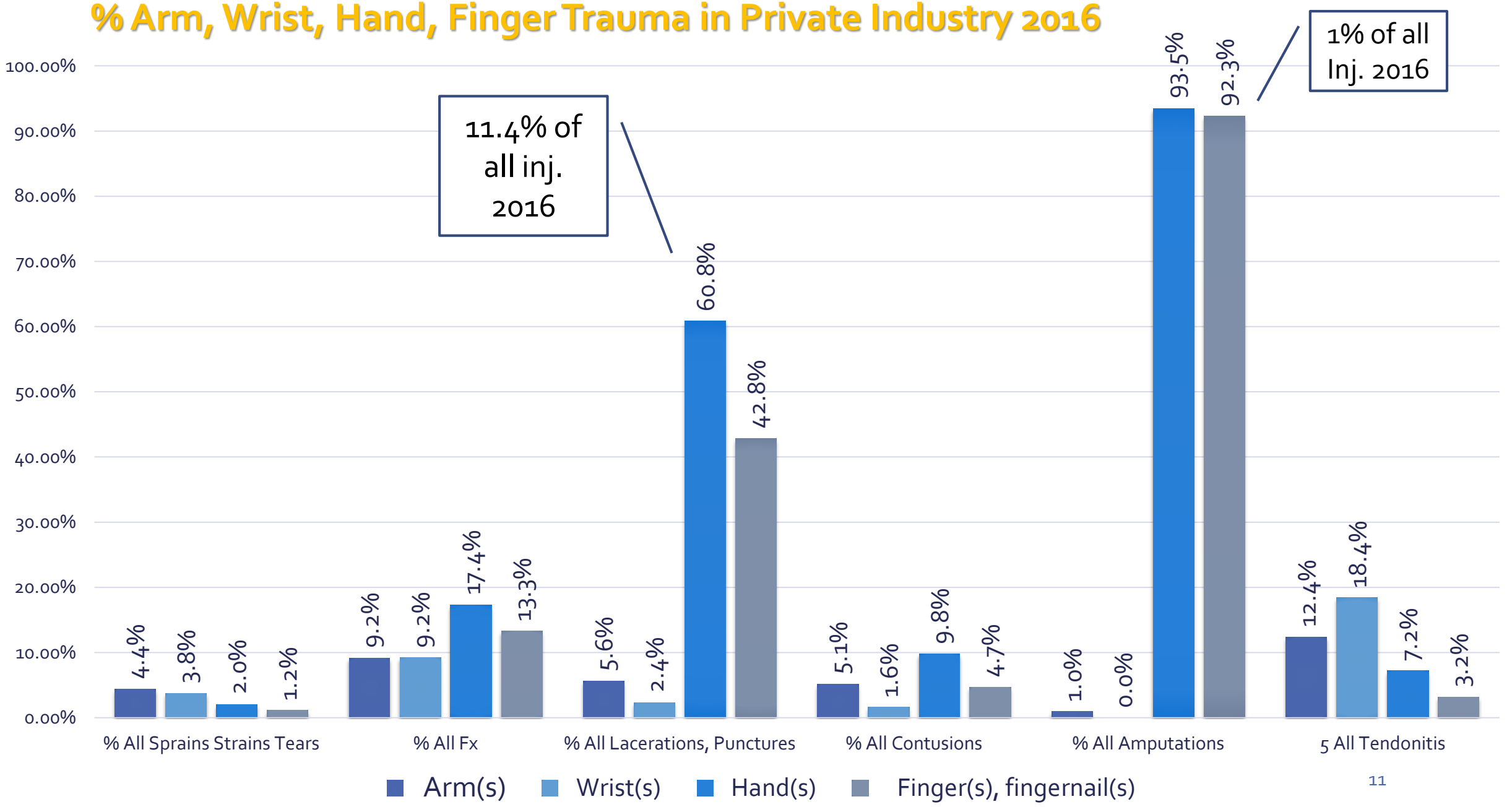
Image Source: Safety Council of NC, www. Safetync.org

Nonfatal occupational injury and illness incidence rates for cases with days away from work by selected nature of injury or illness, all ownerships, 2012-16

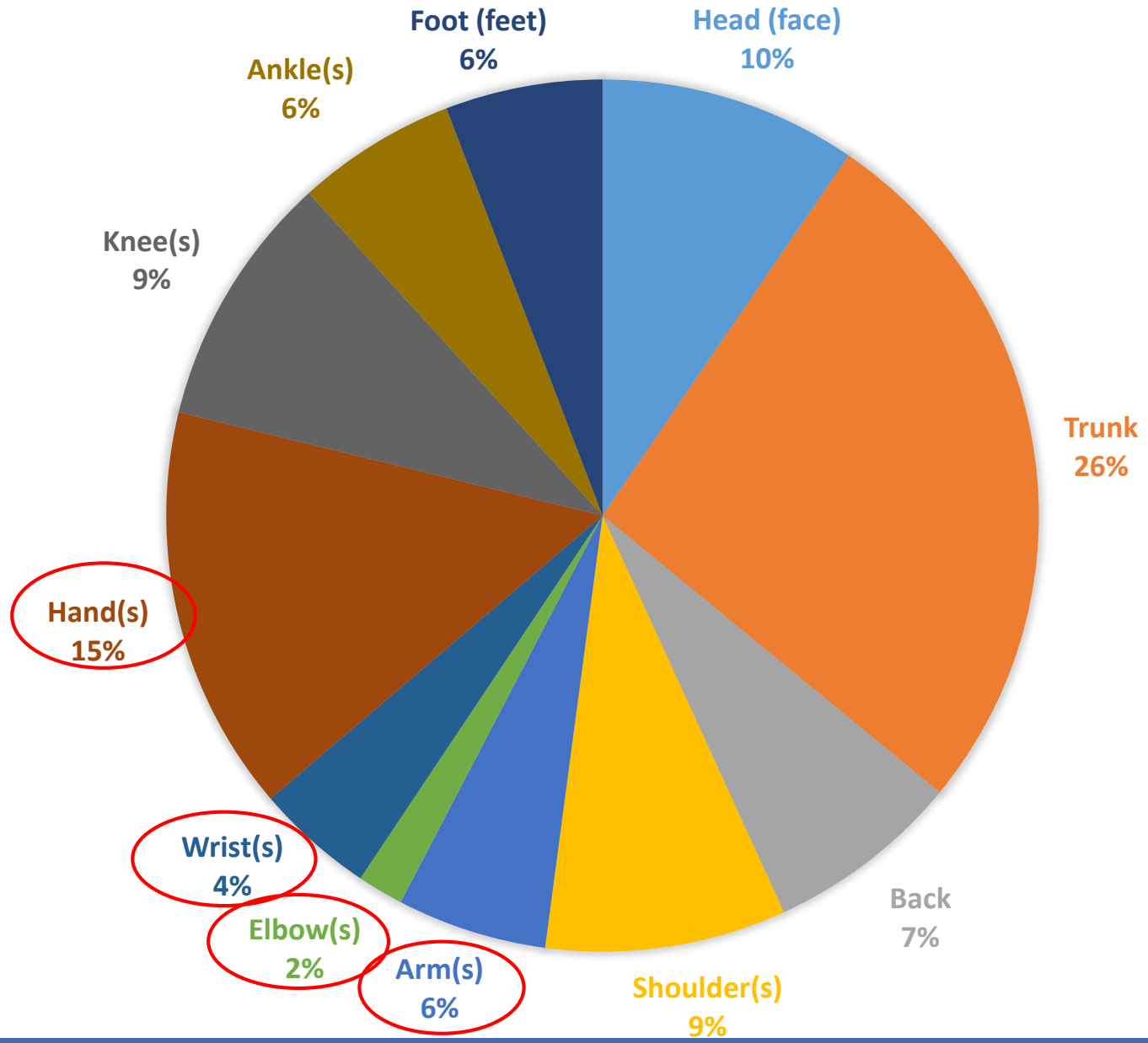


Across the five-year period 2012 to 2016, the rate of occupational injuries and illnesses resulting in sprains, strains, or tears decreased from 42.7 cases per 10,000 full-time equivalent workers in 2012 to 36.3 cases in 2016.

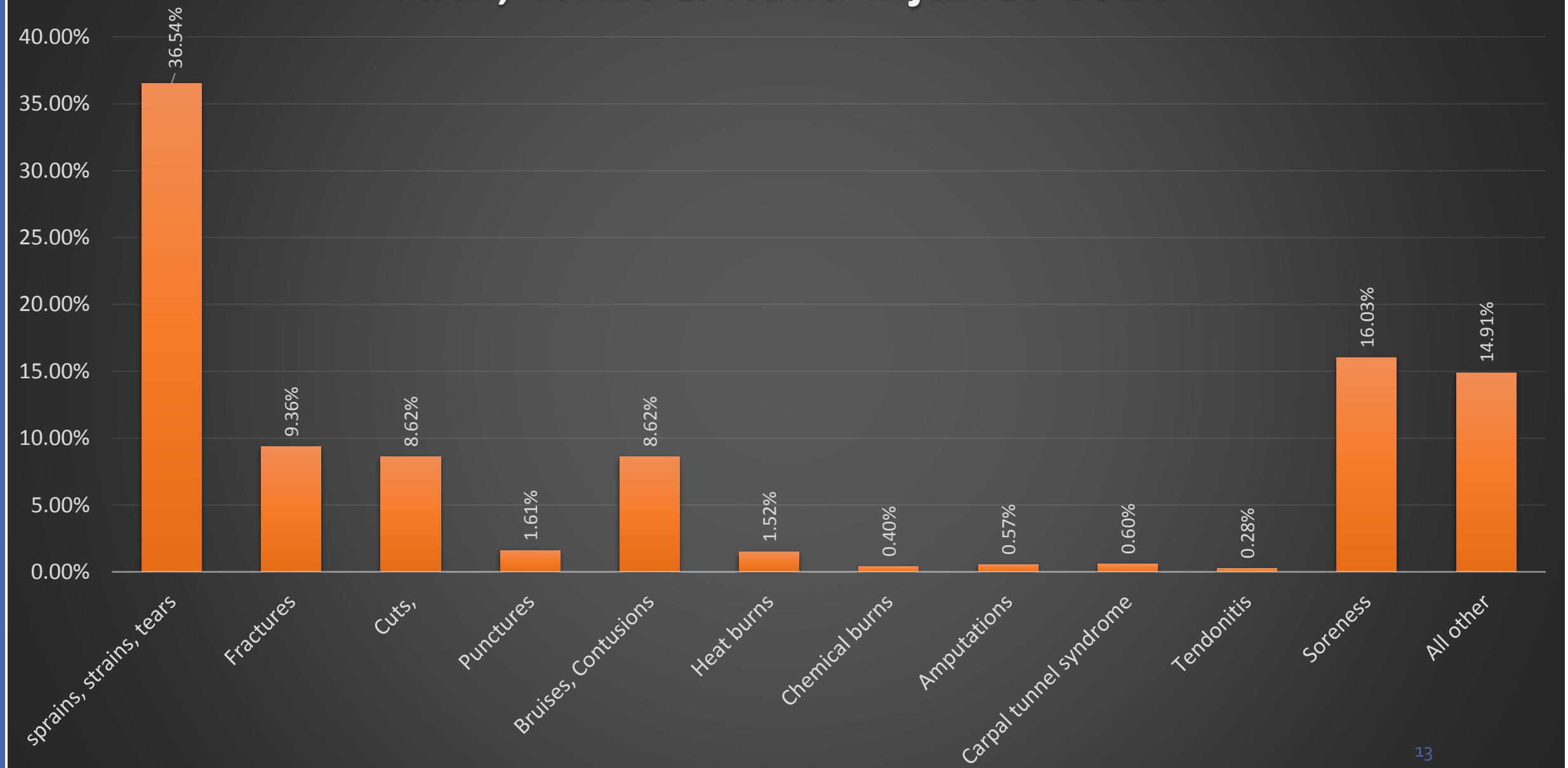
% Arm, Wrist, Hand, Finger Trauma in Private Industry 2016



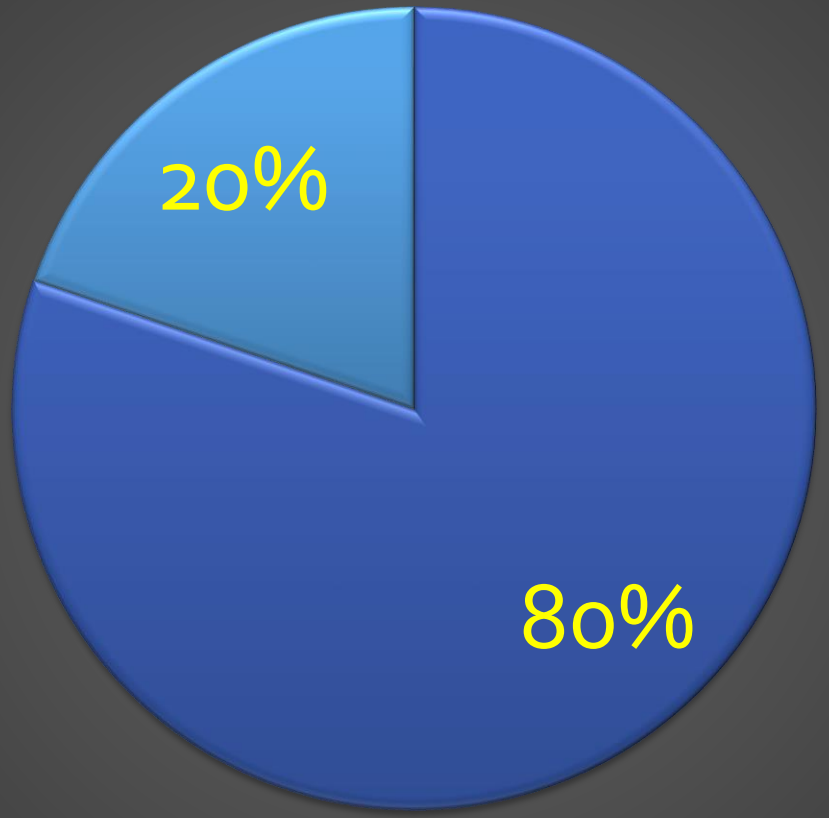
PERCENT ALL INJURIES PRIVATE SECTOR 2016



Arm, Wrist & Hand Injuries 2016

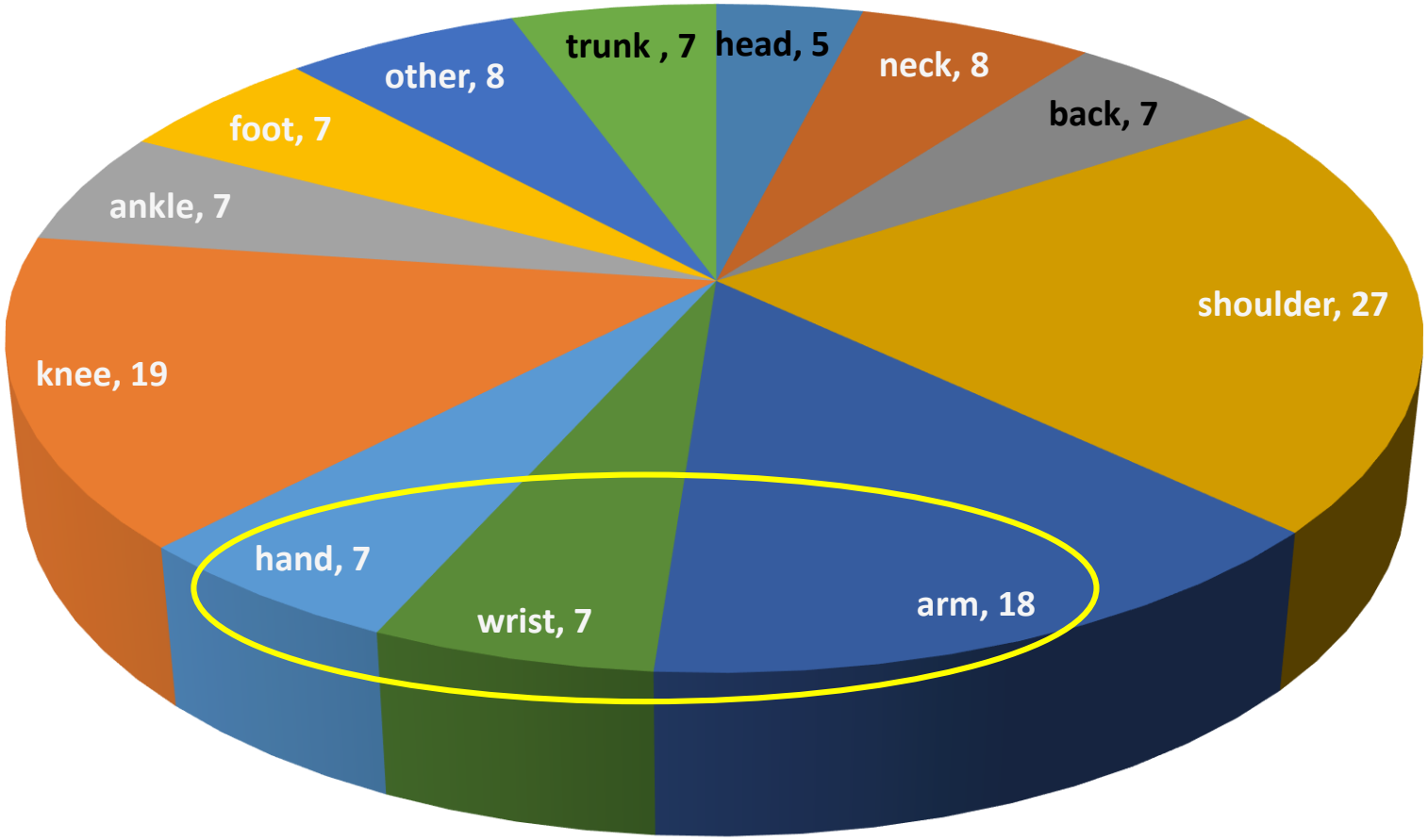


Major Causes of MSD



- Overexertion in lifting or lowering
- Repetitive motion involving microtask

Median Days Away from Work



BLS US, Dept of Labor 2016 Survey of Occupational Injuries & Illness Charts Package , Nov 9, 2017

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

	Median days away from work	Incidence rate per 10,000 full-time workers
Multiple injuries with fractures	43	Less than 0.5
Fractures	32	8.5
Carpal tunnel syndrome	25	0.5
Amputations	23	0.5
Tendonitis	16	Less than 0.5
Sprains, strains, tears	10	36.3
Multiple traumatic injuries	10	2.6
Soreness, pain	8	16.8
Multiple injuries with sprains	7	1.2
Heat (thermal) burns	6	1.4
Bruises, contusions	4	8.8
Chemical burns and corrosions	3	Less than 0.5
Cuts, lacerations	3	7.8
Punctures (except gunshots)	3	1.6
Cuts, lacerations, punctures	3	9.3

Median days away from work
(All ownerships median days = 9)
Days-away-from-work rate
(All ownerships rate = 100.4)

50 40 30 20 10 0
Median days away from work

0.0 10.0 20.0 30.0 40.0
Incidence rate per 10,000 full-time workers

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.

Check Your Knowledge

Which of these arm, wrist and hand injuries is most common of all injuries reported in private industry?

a) Sprains, Strains & tears
b) Fractures
c) Lacerations and punctures
d) Contusions
e) Amputations
f) Tendinitis

Check Your Knowledge

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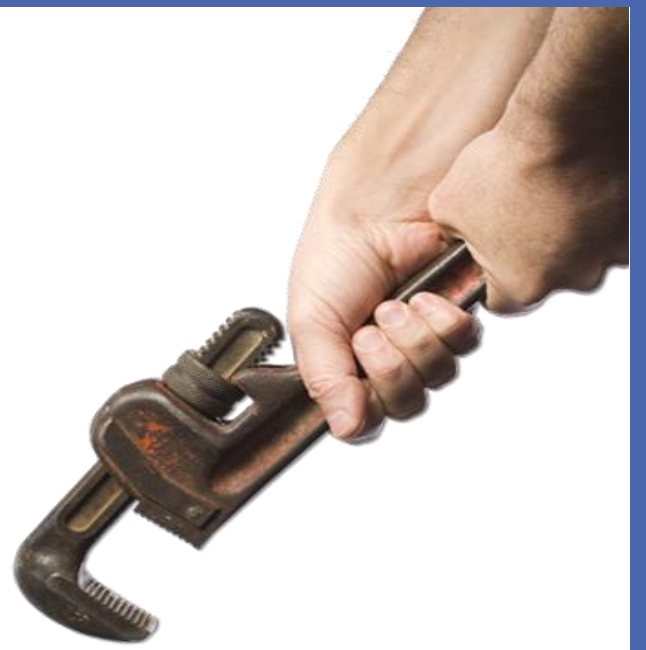
a) Sprains, Strains & tears
b) Fractures
✓ c) Lacerations and punctures
d) Contusions
e) Amputations
f) Tendinitis

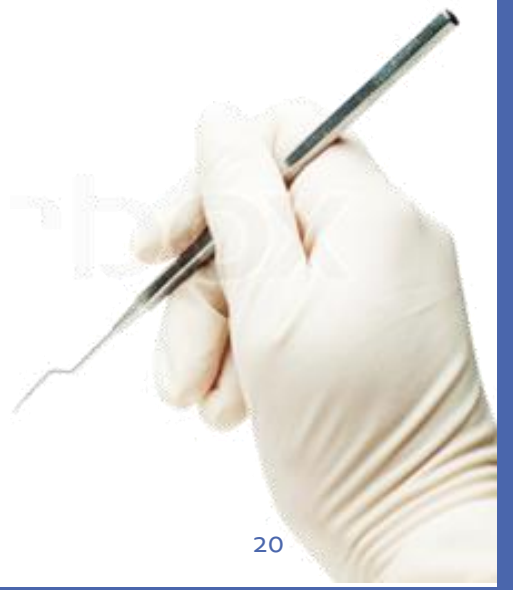
Characteristics of MSDs

- Occur from a single event or 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 MSD may differ in severity from person to person doing a similar task

General Signs of MSDs

- Less strength for gripping
- Less range of motion
- Loss of muscle function
- Inability to do everyday tasks





UE MSD Symptoms

- **Shoulders —**pain, stiffness, loss of mobility
- **Arms —** shooting pains, numbness
- **Elbow —** pain, swelling, stiffness, soreness

MSD Symptoms (cont.)

- **Hands and wrists—** swelling, numbness, loss of strength
- **Fingers—**jerking movements, or loss
  of strength, mobility, and feeling
- **Thumbs—**pain at the base

Outward Signs of MSDs

- Swelling or inflammation of joints
- Vigorously shaking hands
- Massaging hands, wrists, or arms
- Cradling arms
- Limping
- Stiff back

Common MSDs of the UE

- Carpal tunnel syndrome
- Nerve Compression
- Tendonitis (elbow)
- Tenosynovitis
  - De Quervain's
  - Trigger Finger
- Strains / Sprains
- Thoracic Outlet Syndrome

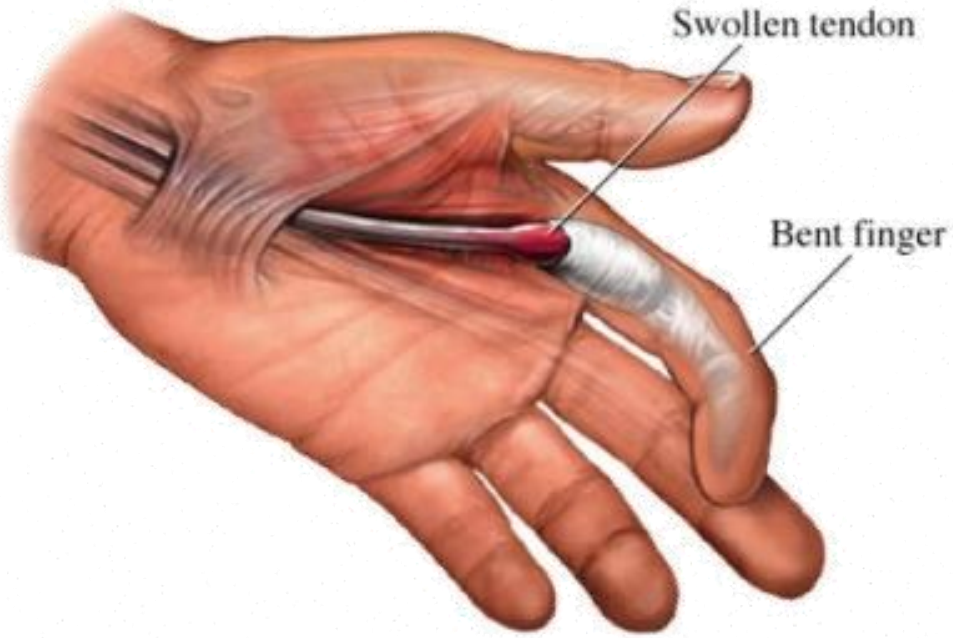
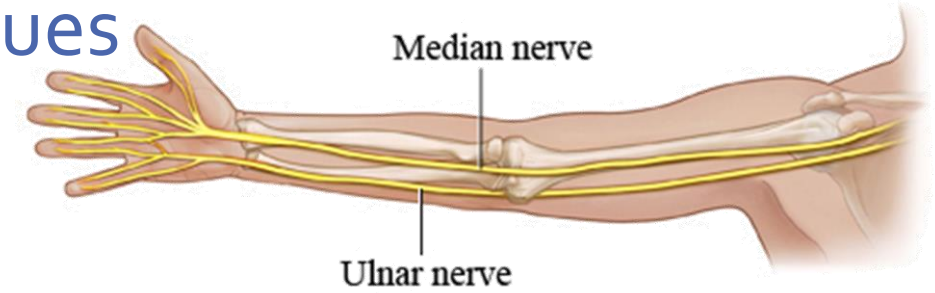
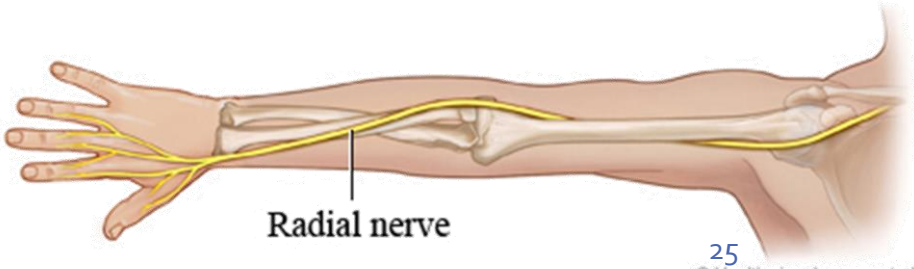


Image Credit: Sport & Spine Rehab: http://www.ssrehab.com/conditions/wristhand/trigger-finger/

Nerve Compression / Entrapment?

1) Repeated motions
2) Tight muscles
3) Inflammation of surrounding tissues
4) Misalignment of the nerve





Common Nerve injuries?

I. Thoracic Outlet Syndrome: brachial plexus compression

II. Radial tunnel syndrome: compressed radial nerve @ outside of elbow

III. Cubital tunnel syndrome: ulnar nerve compression inside of the elbow

IV. Carpal tunnel syndrome: compression of median nerve at level of carpal tunnel

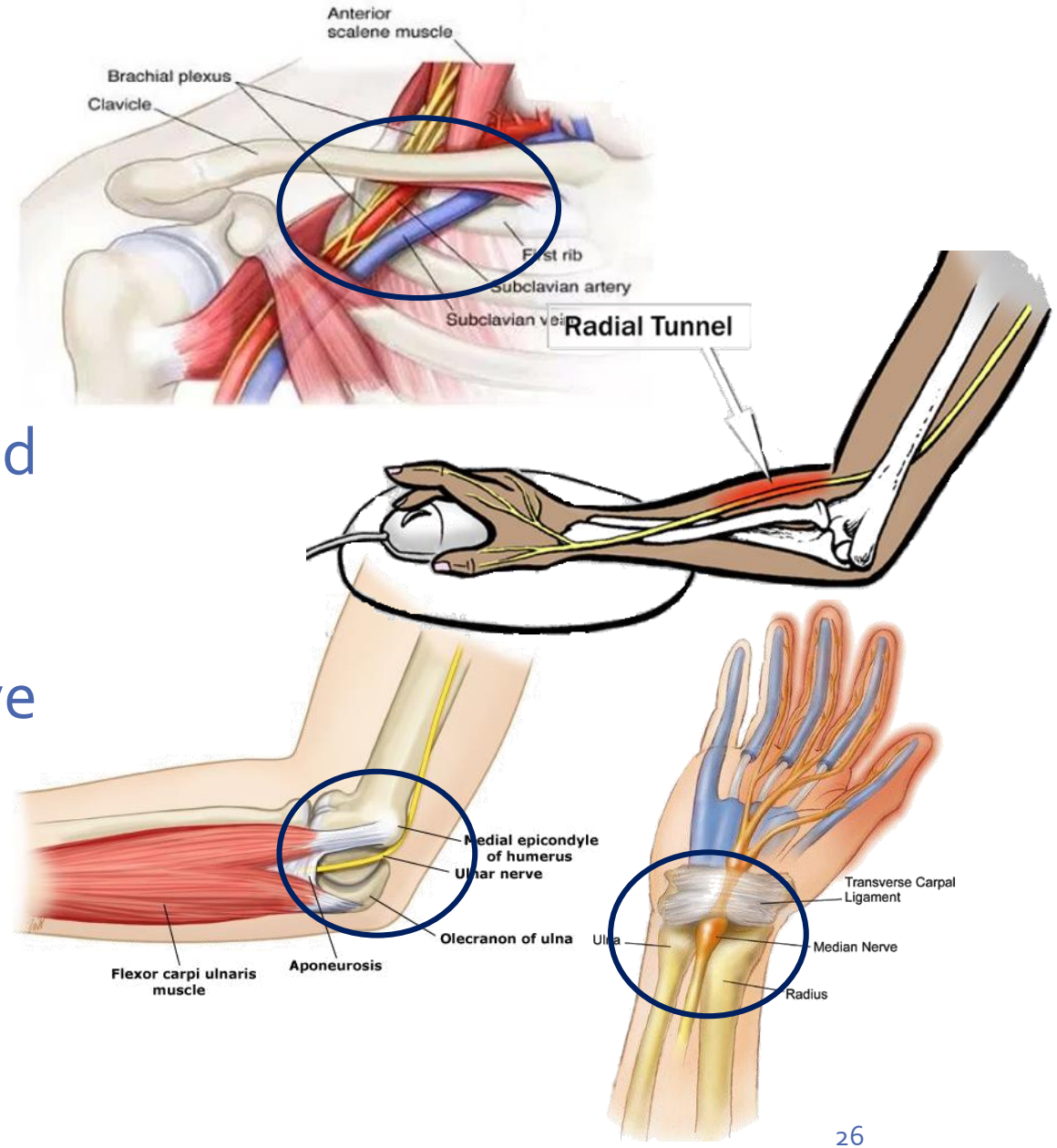


Image credit: http://www.whitetigernaturalmedicine.com/wp-content/uploads/2012/03/Radial-Tunnel-Syndrome.jpg, & http://www.natural-health-remedies-and-more.com/carpal-tunnel-syndrome.html
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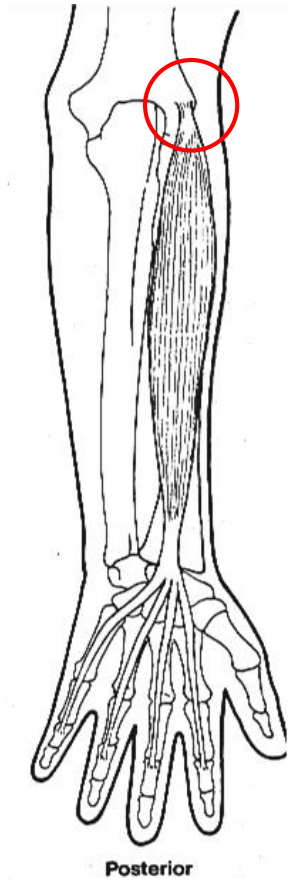
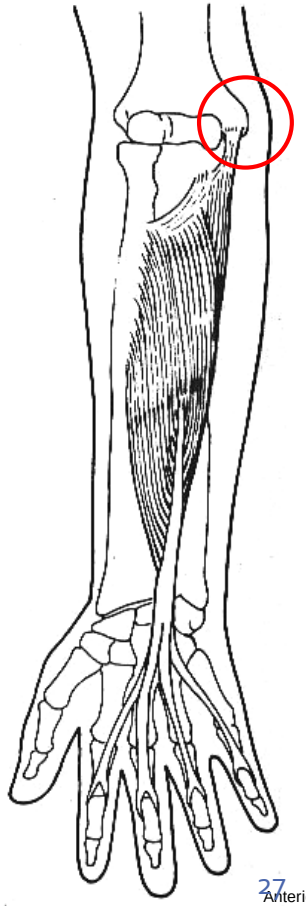
UE Tendons and Tendonitis

- Tendons of wrist & hand very small; @ high risk for injury w/ overuse
- "Tennis elbow" or lateral epicondylitis affects *finger extensor* tendons outside of elbow
- "Golfer's elbow" or medical epicondylitis affects finger flexor tendons inside of elbow

Extensor Digitorum

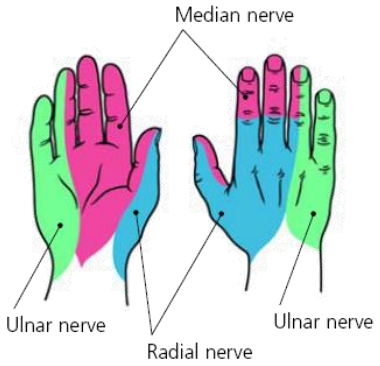


Flexor Digitorum Superficialis



Carpal Tunnel Clinical S/Sx

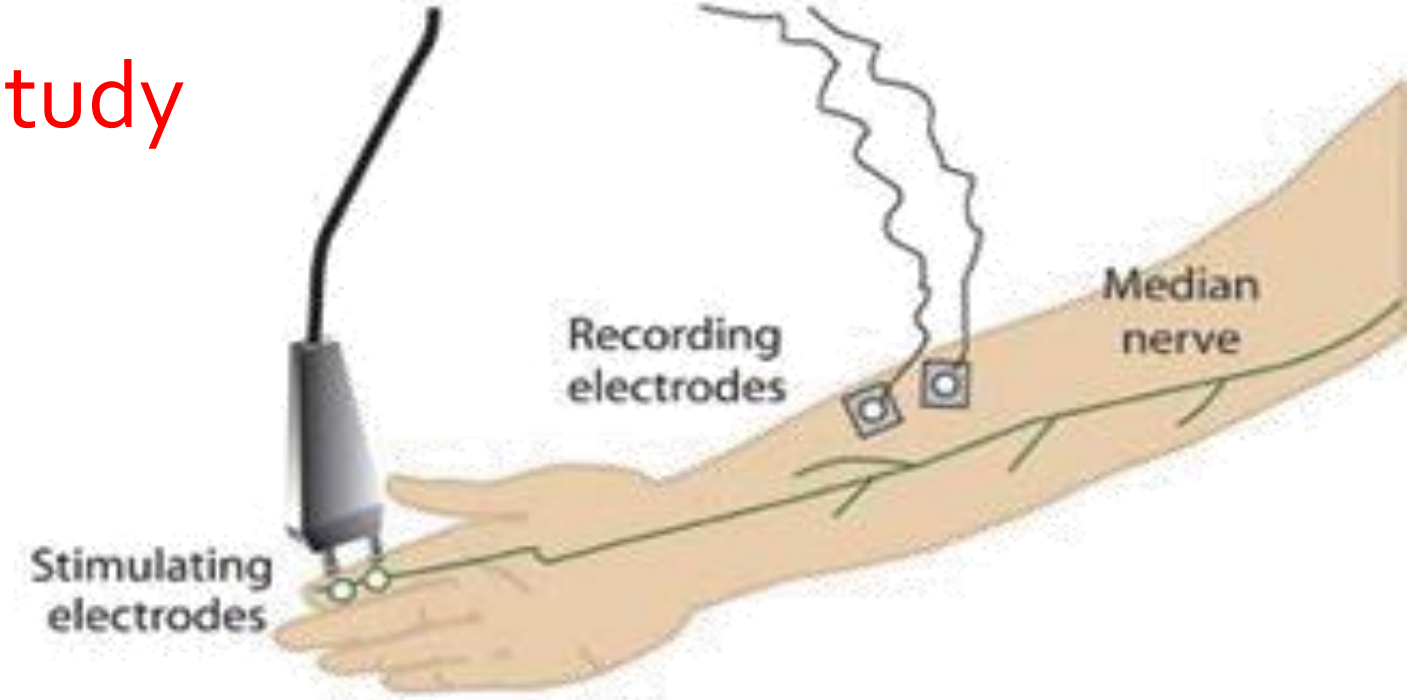
- Pain
- Numbness
- Tingling
- Sx are usually worse at night and can awaken patients from sleep.
- Flick sign



- Pain and paresthesia may radiate to the forearm, elbow, and shoulder.
- Decreased grip strength
- Loss of dexterity
- Thenar muscle atrophy in severe cases

Carpal Tunnel Dx

- History
- Physical examination
- Nerve Conduction Study



Carpal Tunnel Tx

- CONSERVATIVE TREATMENTS
  - GENERAL MEASURES
  - WRIST SPLINTS (most effective when applied w/in three months of the symptom onset)
  - ORAL MEDICATIONS (typically do not work)
  - LOCAL INJECTION
    - Splinting is generally recommended after local corticosteroid injection.
    - If the first injection is successful, a repeat injection can be considered after a few months
    - Surgery should be considered if a patient needs more than two injections
  - ULTRASOUND THERAPY
  - Predicting the Outcome of Conservative Treatment
- SURGERY

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 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

- 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

Check Your Knowledge

Which of these are MSD symptoms?

a) Tingling
b) Racing heart
c) Pain
d) Numbness
e) Loss of muscle function
f) Dizziness
g) Excessive cough
h) Stiffness
i) Swelling of the joints

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- ☒ f) Dizziness
- ☒ g) Excessive cough
- ✓ h) Stiffness
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WORKPLACE CHARACTERISTICS THAT MAY CONTRIBUTE TO INJURY

What 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.

What two elements are at work?

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

Risk Factors: Awkward Postures

- Stress on muscles and tendons
- Contributing factors
  - Reaching overhead
  - Force the body must maintain to hold the position
  - Holding fixed positions (static loading)
- Lifting while twisting, reaching, or turning

Image credit: *P. Rast*

Risk Factors: Contact Stress

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

Image credit: *Business & Legal Reports*

Risk Factors: Vibration

- Affects tendons, muscles, joints, nerves
- Contributing factors
  - Prolonged grip
  - Restricts blood supply to hands and fingers
  - Tools without vibration dampening device
  - Poor power tool maintenance

Image credit: *Business & Legal Reports*

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)

FACTS

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

Risk Factors That Lead to MSDs

- Repetitive motions
- Forceful exertions
- Awkward postures
- Contact stress (pressure points)
- Vibrations

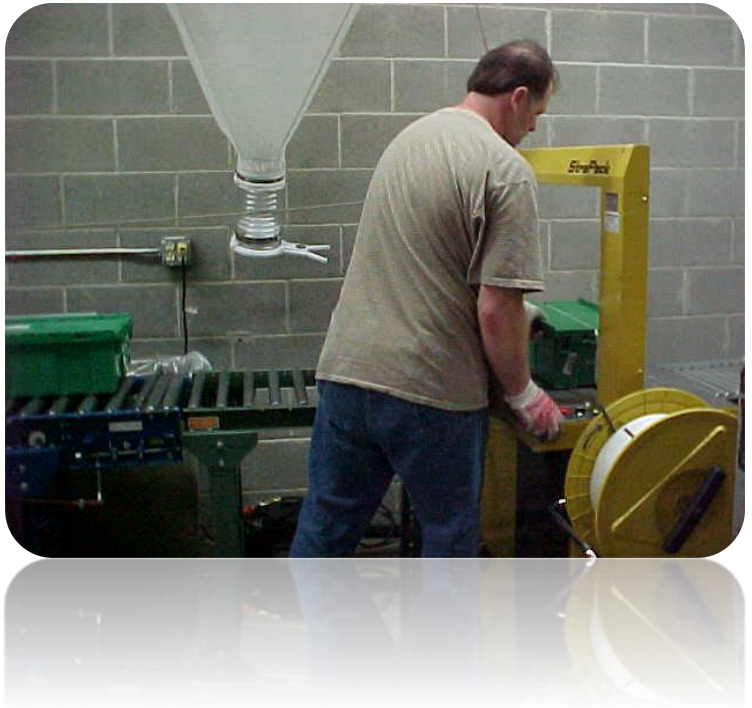

Image credit: *P. Rast*

Risk Factor— Repetitive Motion

- Stress on muscles and tendons
- Contributing factors
  - Duration and speed of repetitious movement
  - Number of muscles involved
  - Required force
- Raising and lowering the arm over and over again

Image credit: *Business & Legal Reports*

Risk Factor: Forceful Exertions

- Inflammation of tendons, nerves, joints
- Contributing factors
  - Type of grip
  - Weight of object
  - Body posture
  - Type and duration of the task

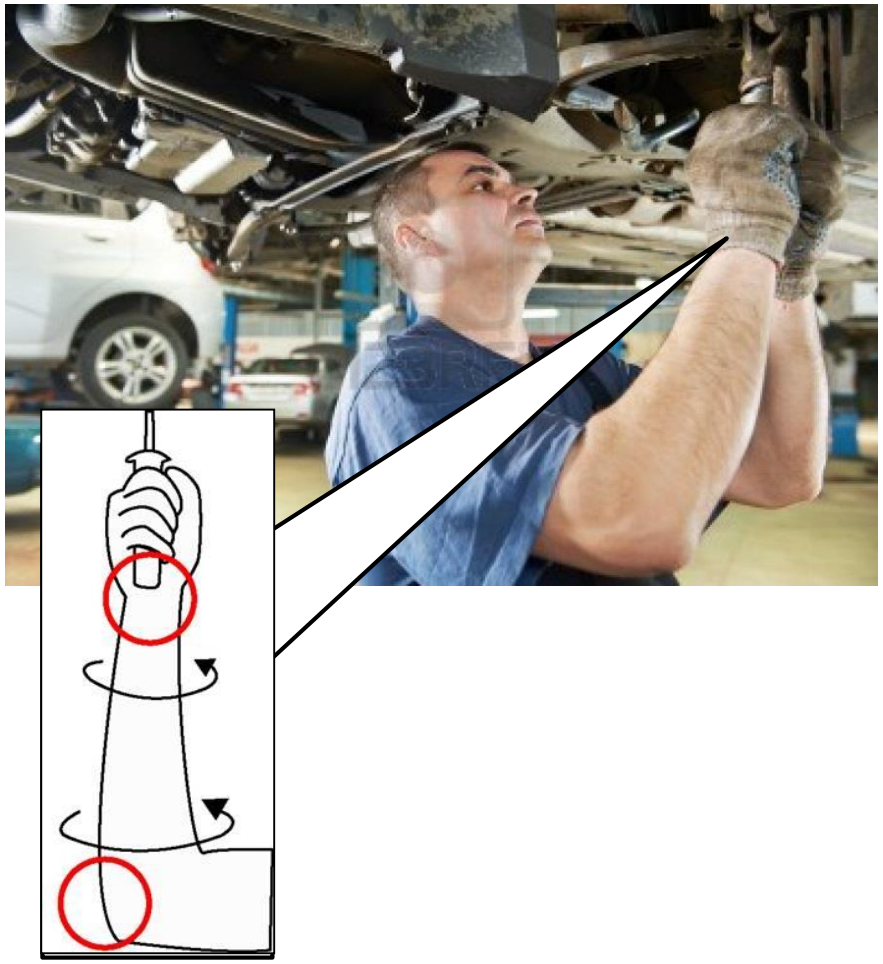

Image Credit: OSHA

Check Your Knowledge

The two elements that lead to MSDs are increased force required for arm position and…

a) Static work position

b) Position that requires movement

c) Adjustable work stations

d) Frequent stretching breaks

Check Your Knowledge

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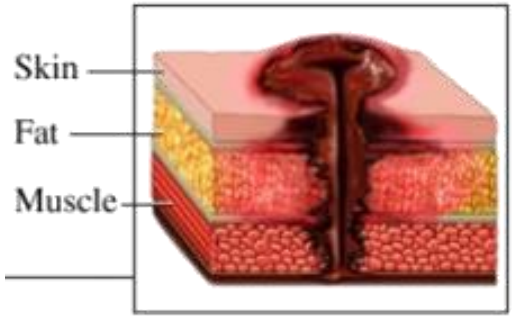
Common Traumatic UE Injuries

- Skin
  - Contusions
  - Punctures
  - Lacerations
  - Burns
- Tendon
  - Rupture

Puncture Wound

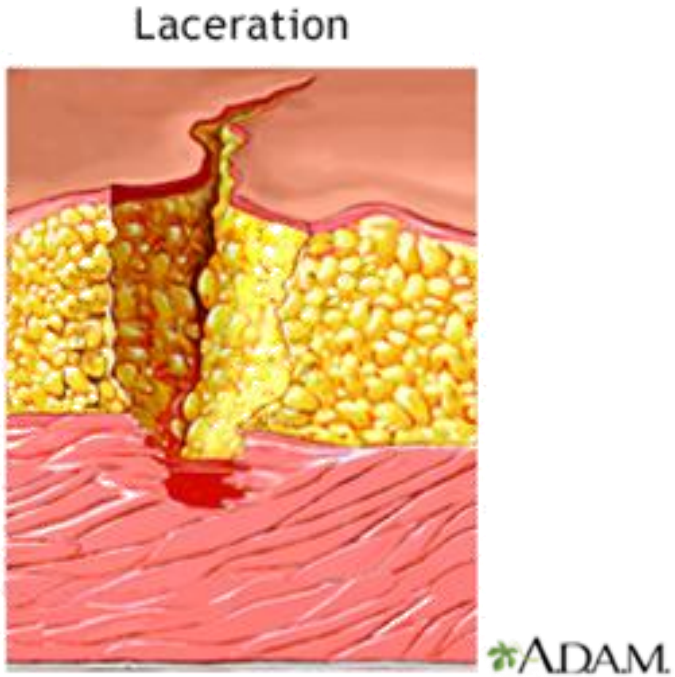
- Penetration of skin by sharp object
  - Nails, tacks, ice picks, knives, teeth, needles
- May be small in diameter and not seem serious
- Do require treatment by physician
- Can become infected easily b/c dirt and germs carried deep in the tissue



Deep puncture wound

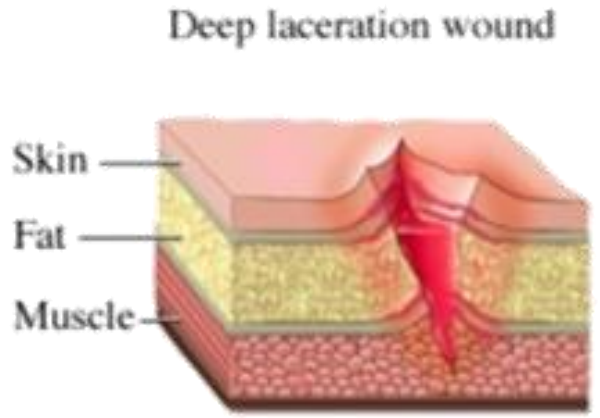
Laceration

Recall that lacerations of Arm, Wrist, Hand, & Fingers make up 11.4% of all workplace injuries in private industry (BLS, 2016)



Laceration

- Flesh irregularly torn; cut or tear in the skin
- Minimal bleeding, minimal pain, & no numbness or tingling
- Cuts ≤ 0.25" (6mm) deep and 0.5" (1.3cm) long & have smooth, edges→ can be treated at home
- Deeper lacerations should be treated by physician (stitches)

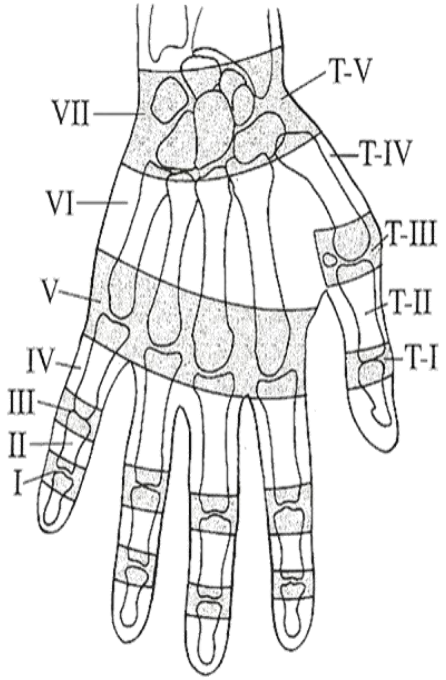


Lacerations

- Regardless of size, always have a high suspicion for more serious injury.
- Lacerated tendon when repaired takes 6-8 weeks of healing and hand therapy to recover.
- Nerve repairs often take 3-6 months to get some benefit from the repair

Extensor Tendon injuries

- Divided into Zones according to anatomical location of injury
- In the hand and wrist there are **7** extensor tendon zones



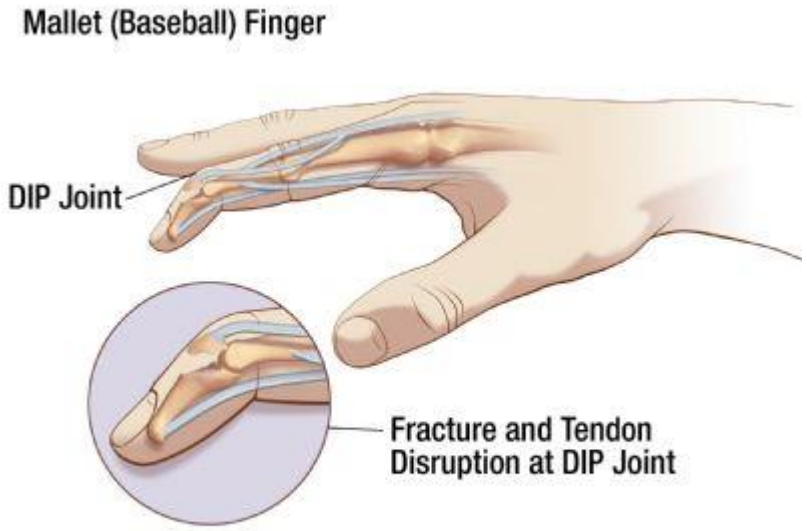
Zones of extensor tendon injury

The Verdan Extensor Tendon Injury Classification System	
Zone	Anatomical Location
I	DIP Joint
II	Middle Phalanx
III	PIP Joint
IV	Proximal Phalanx
V	MCP Joint
VI	Metacarpals
VII	Carpals
VIII	Proximal Wrist
Source: Kleinert, Harold E. et al. (1983).	

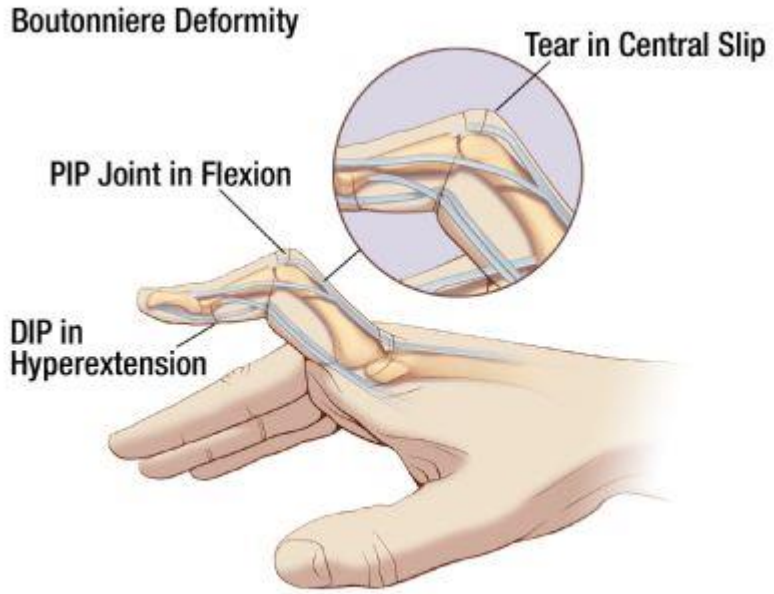
Zone	Presentation	Management
I	Mallet Deformity	•Closed: splinting 6-8 weeks •Open: suture repair for fixation. Soft tissue reconstruction
III	Boutonniere's Deformity	•Closed: splinting MCP and PIP in hyperextension for 6 weeks •Open: suture repair (figure of 8 suture)
V	Fixed flexion of MCP	•Closed: splinting ,45 extension at wrist and 20 flexion at MCP •Open: suture repair.
VII	Fixed flexion of MCP	•Suture repair followed by post-op splinting

Deformities

- Mallet finger



- Boutonniere deformity
- Z deformity of the thumb

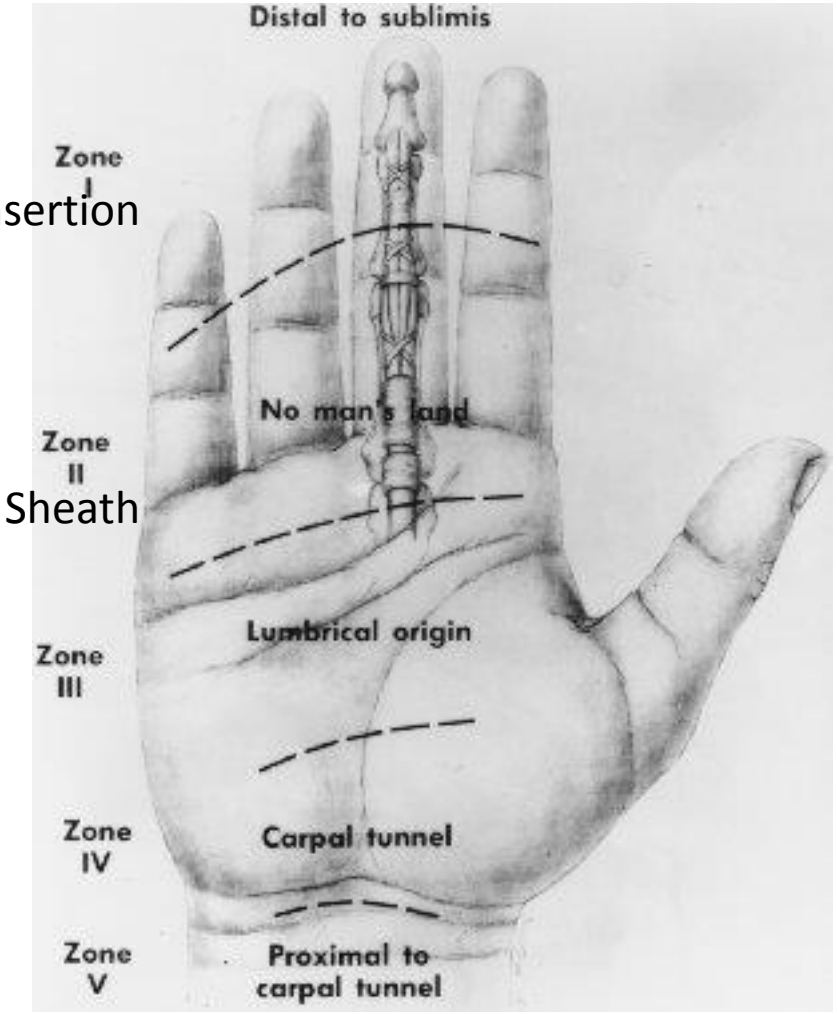


Flexor tendon injuries –

5 zones in the hand and the wrist

FDS Insertion

Flexor Sheath



Flexor Tendon Zones – Image Credit:odlarmed

5 zones in the hand and the wrist	
Zone	Anatomical Location
I	One tendon only (FDP) from middle of middle phalanx
II	Two tendons (FDS & FDP) from MCP joints to middle of middle phalanx
III	Central palm
IV	Tendons in the carpal tunnel
V	Tendons proximal to the carpal tunnel
Source: http://boneandspine.com/flexor-tendon-zones-of-hand/	

Zone	Presentation	Management
I	Loss of active flexion at DIP joint Hyperextension of DIP joint (Jersey finger)	•Primary or Secondary tendon repair •Careful suturing prevent post-op adhesions.
II	Loss of active flexion at MCP joint	•Skin closure then secondary repair by tendon grafting •Primary repair performed by skilled hand surgeon to minimize post-op adhesions.
III, IV Thumb	Same	•Primary or secondary tendon repair •Examine carefully for thenar muscle injury and recurrent branches of median nerve.

Hand Injury Risk

- The risk of a hand injury was significantly elevated when:
  - Working with equipment
  - Working with tools
  - Work pieces not performing as expected
  - Using a different work method to do a task
  - Doing an unusual task
  - Being distracted, and/or rushed.

Reducing Laceration Risk

- Cut resistant gloves/sleeves/clothing
- Regular inspection of equipment and product
- Guard, pad or eliminate edges
- Good housekeeping and organization
- Use proper tools for removal of turnings, chips & stringers
- Proper removal & disposal of broken glass

Reducing Laceration Risk

- Choose proper tool for cutting
- Maintain sharp bladed tools
- Always cut away from the body
- Use cutting tools with safety devices
- Training – recognition of potential sources of injury

Avoiding Hand Injuries

- Be aware of pinch points
- Be aware of hot areas
- Be aware of rotating or moving surfaces
- Use remote or delay timing to control automated machinery Loose clothing and jewelry may be caught up in moving machinery
- Never remove machine safeguards or operate machinery with safeguards removed

Types of Gloves

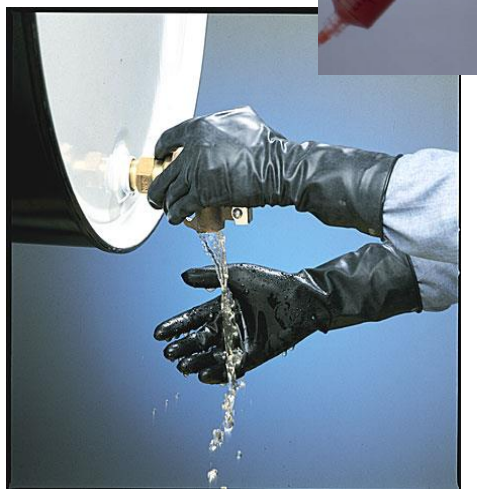
1. Leather gloves - protect from rough surfaces.
2. Special insulated gloves - provide protection from hot objects.
3. Cut-resistant gloves - prevent or reduce cuts from sharp edges.

Types of Gloves

4. Anti-vibration gloves - reduce the effects of excessive vibration from hand-tools and machinery.

5. Disposable gloves - protect against blood and germs in healthcare.

6. Chemical resistant gloves - prevent contact with chemicals.



7. Electrically Insulated Gloves

- Certified Linesman's Gloves
  - Specialty gloves are used to handle live wires or energized electrical equipment.
  - Must be electrically tested every 6 months.
  - Can not be used if not tested within past 12 months
  - Should be checked for obvious signs of wear or holes before using.

(Optional Slide)

Glove Limitations

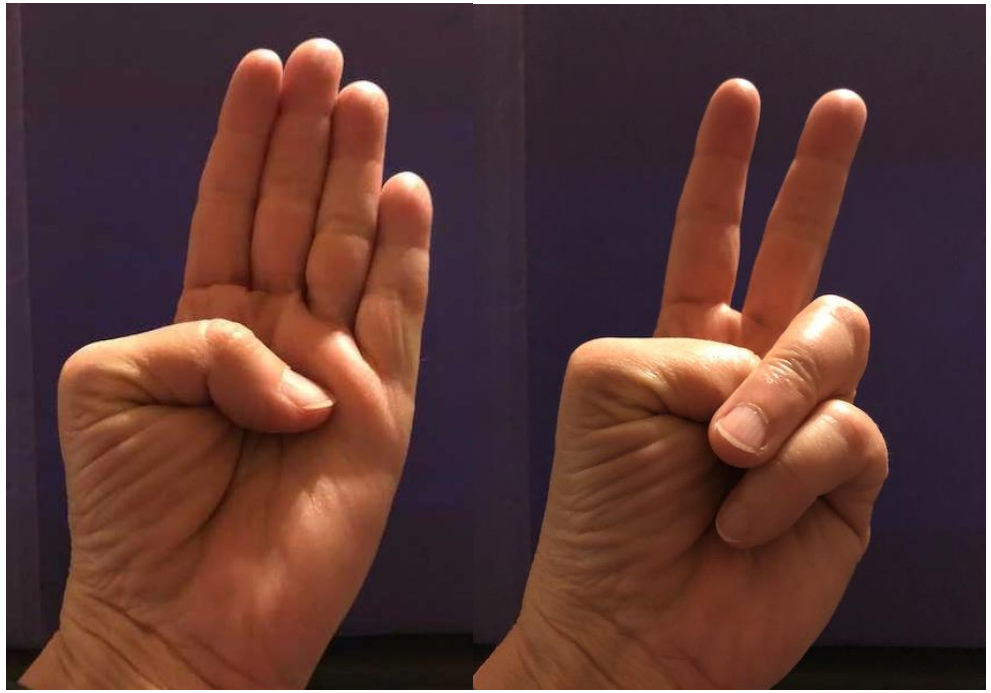
- Gloves can get caught in rotating machinery
- Latex glove allergies
- Gloves can fail in conditions of extreme temperatures, high mechanical force, high vibration or handling extremely harsh chemicals.
- The wrong size glove can cause extra stress on the hands.

Too big

Better fit

Practical Exercise:

1. Tuck your thumbs into the palms of your hands
2. Now
   a) Draw a flower with a pen or pencil
   b) Tie your shoes



Hand Injuries

- Hand injuries are difficult to repair because of the complexity of the hand
- After a hand injury, the hand may not function as it did before the injury due to loss of:
  - Motion
  - Dexterity
  - Grip
  - Ability to complete the simplest of tasks

Check Your Knowledge

Leather gloves provide protection for which of the following:

a) splinters

b) sheet metal edges

c) acid

d) wire cable

Check Your Knowledge

Leather gloves provide protection for which of the following:

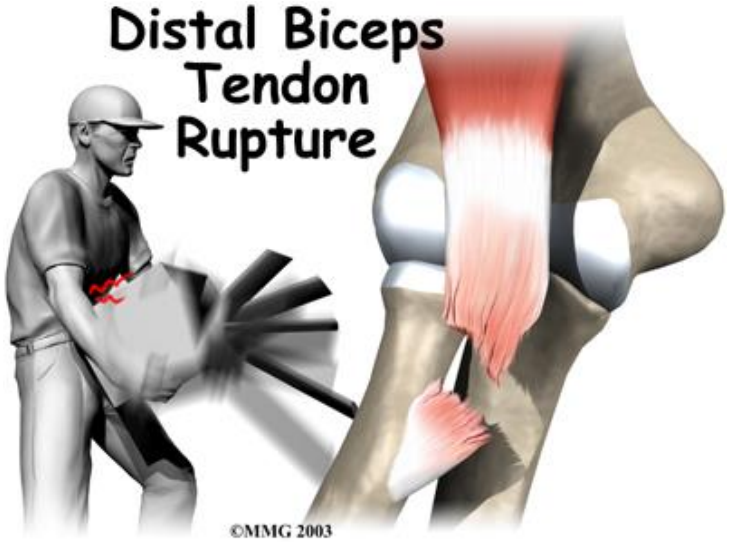
- ✓ a) splinters
- ✓ b) sheet metal edges
- ☒ c) acid
- ✓ d) wire cable

A Word on Elbow Tendon Injuries

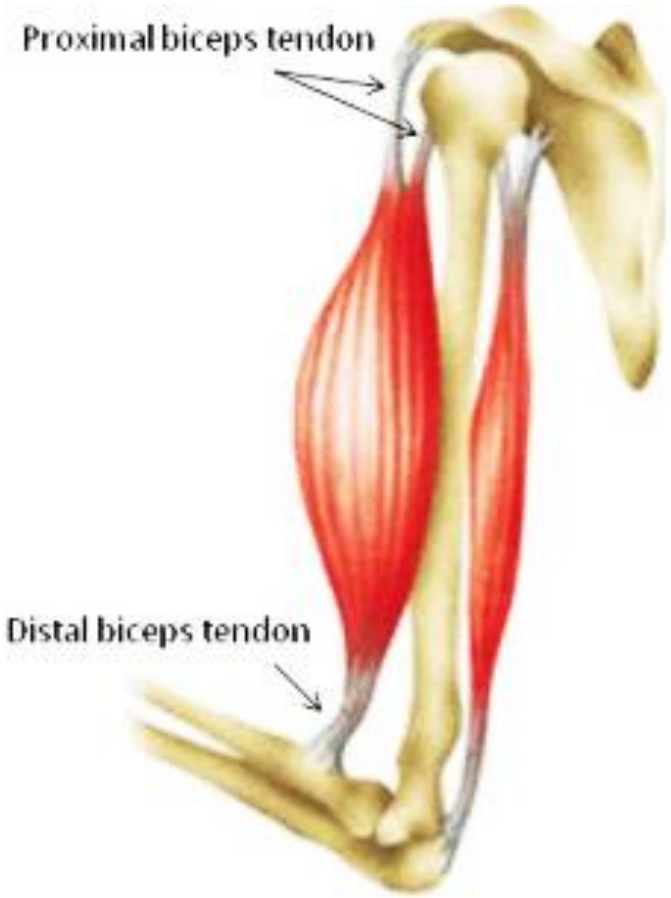
Biceps Tendon Injury

Biceps Tendon Injury

- Distal biceps tendon rupture sudden load on the arm, with elbow flexed against resistance
- proximal biceps tendon rupture - sudden load on the arm, such as hard fall with the arm outstretched

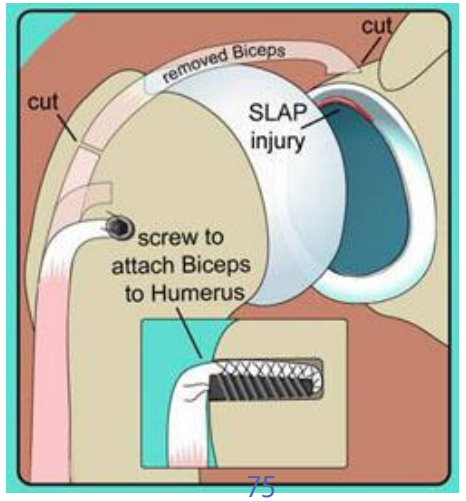


Biceps Tendon Injury



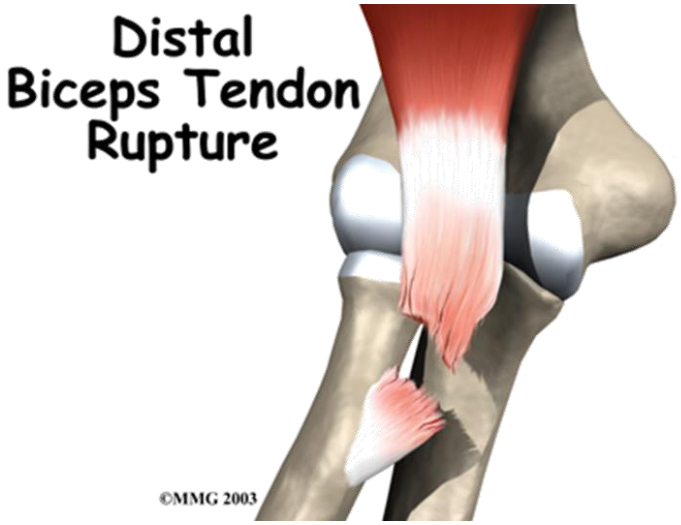
Proximal Biceps Tendon Injury

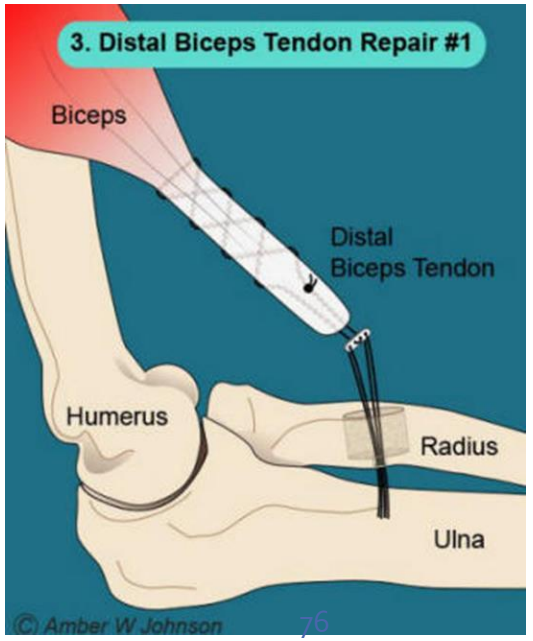
- Conservative treatment for tears in the proximal biceps tendons.
- PRICE
- Nonsteroidal anti-inflammatory medications such as ibuprofen reduce pain.
- Limited activity when pain or weakness.
- ROM and strengthen of surrounding muscles
- Surgical repair of a complete tendon tear for younger individuals whose work involves heavy labor or lifting.



Distal Biceps Tendon Injury

- Partial tears of the distal biceps tendon may be treated either conservatively (expect 40% dec in supination, 30% dec in flexion strength)
- Complete tears of the distal biceps tendon require surgery to reattach the tendon to the bone.
- Range of motion exercises can begin as early as two weeks after surgery, although forceful biceps activity is often restricted for four to six months.





WWOS ?

What would OSHA say?
OSHA's Role in Hand Protection

OSHA® Occupational Safety and Health Administration

Addressed in OSHA Regulation

29 CFR 1910.138 – Hand protection

29 CFR 1910.138

- States that employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as:
  - Skin absorption of harmful substances
  - Severe cuts or lacerations
  - Severe abrasions
  - Punctures
  - Chemical burns
  - Thermal burns
  - Harmful temperature extremes

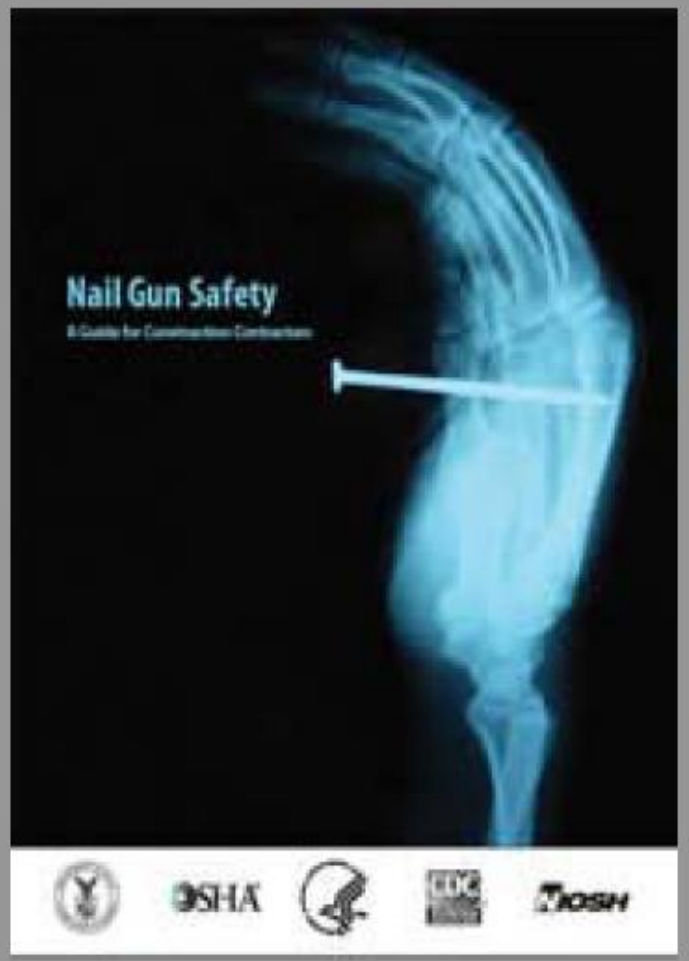
Other OSHA Regulations Related to Hand Safety

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

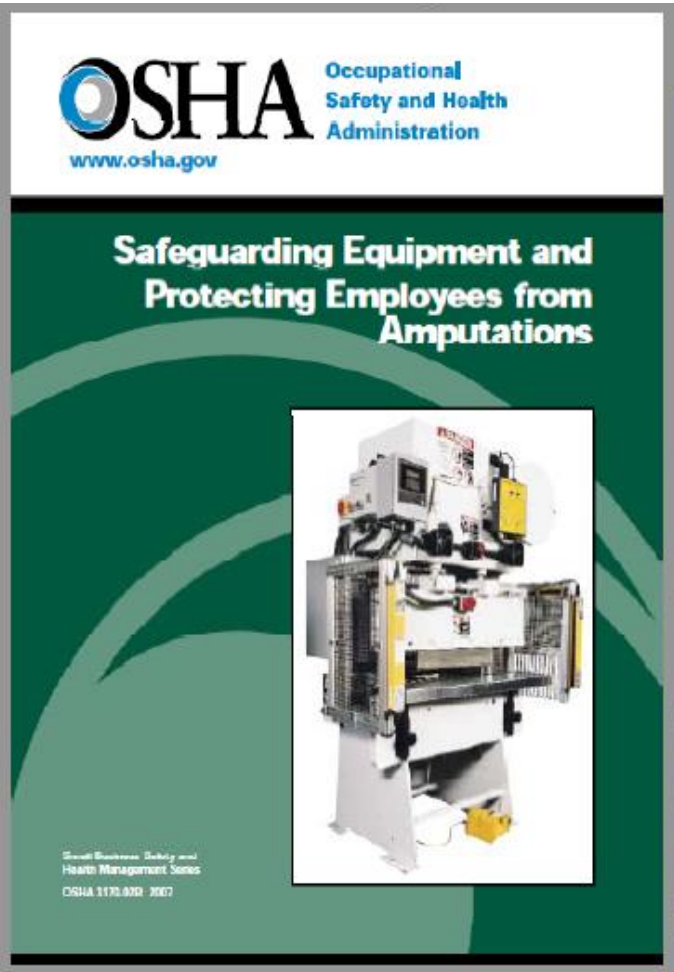
- Control of Hazardous Energy – Lockout/ Tagout (29 CFR 1910.147)

- Machinery and Machine Guarding (29 CFR 1910 Subpart O)

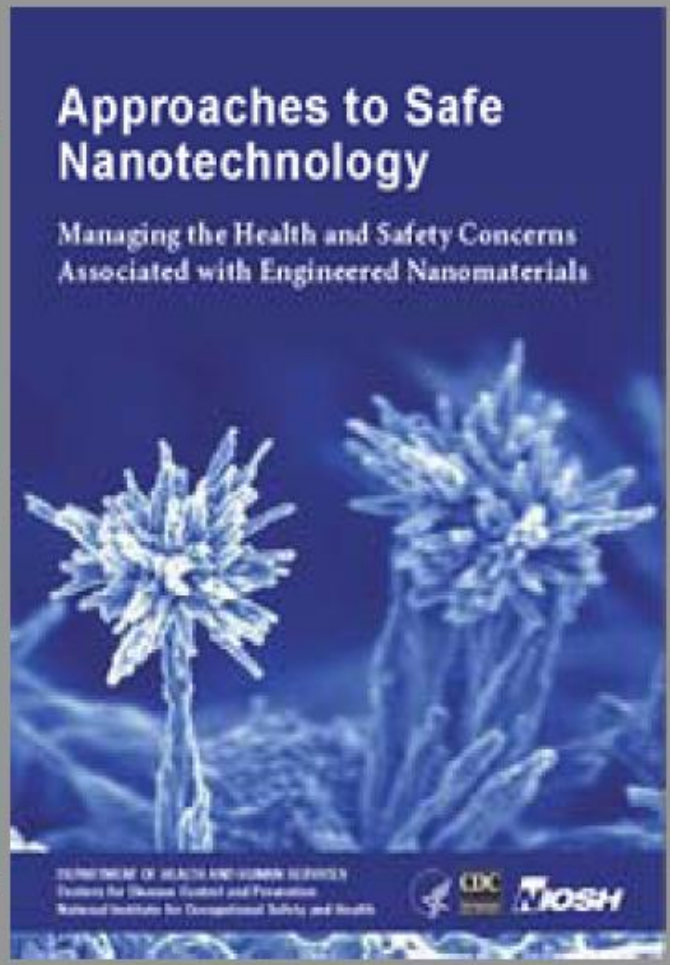
Publications Addressing Major Hazards with Hand Safety



OSHA/ NIOSH 2011

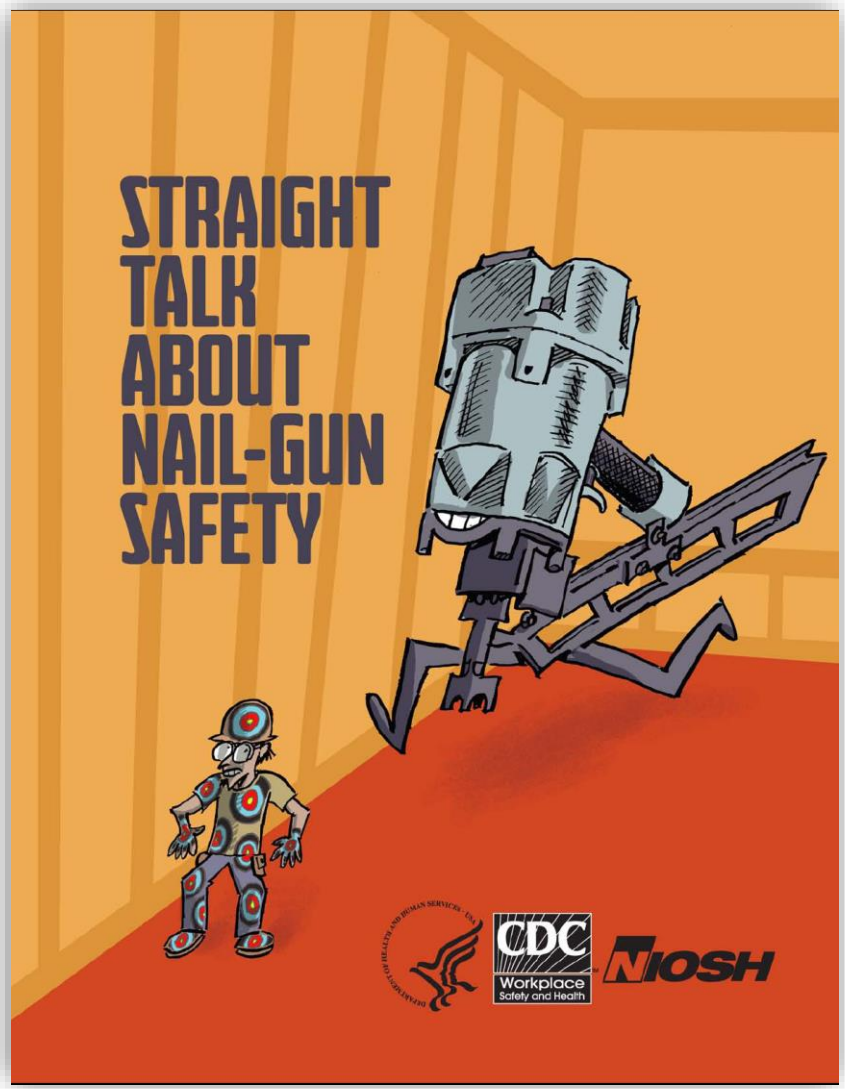


OSHA 2007



NOSH 2009

A comic book based on NIOSH supported research, *Nail Gun Safety: A Guide for Construction Contractors* (2013) https://www.cdc.gov/niosh/docs/2013-149/pdfs/2013-149.pdf



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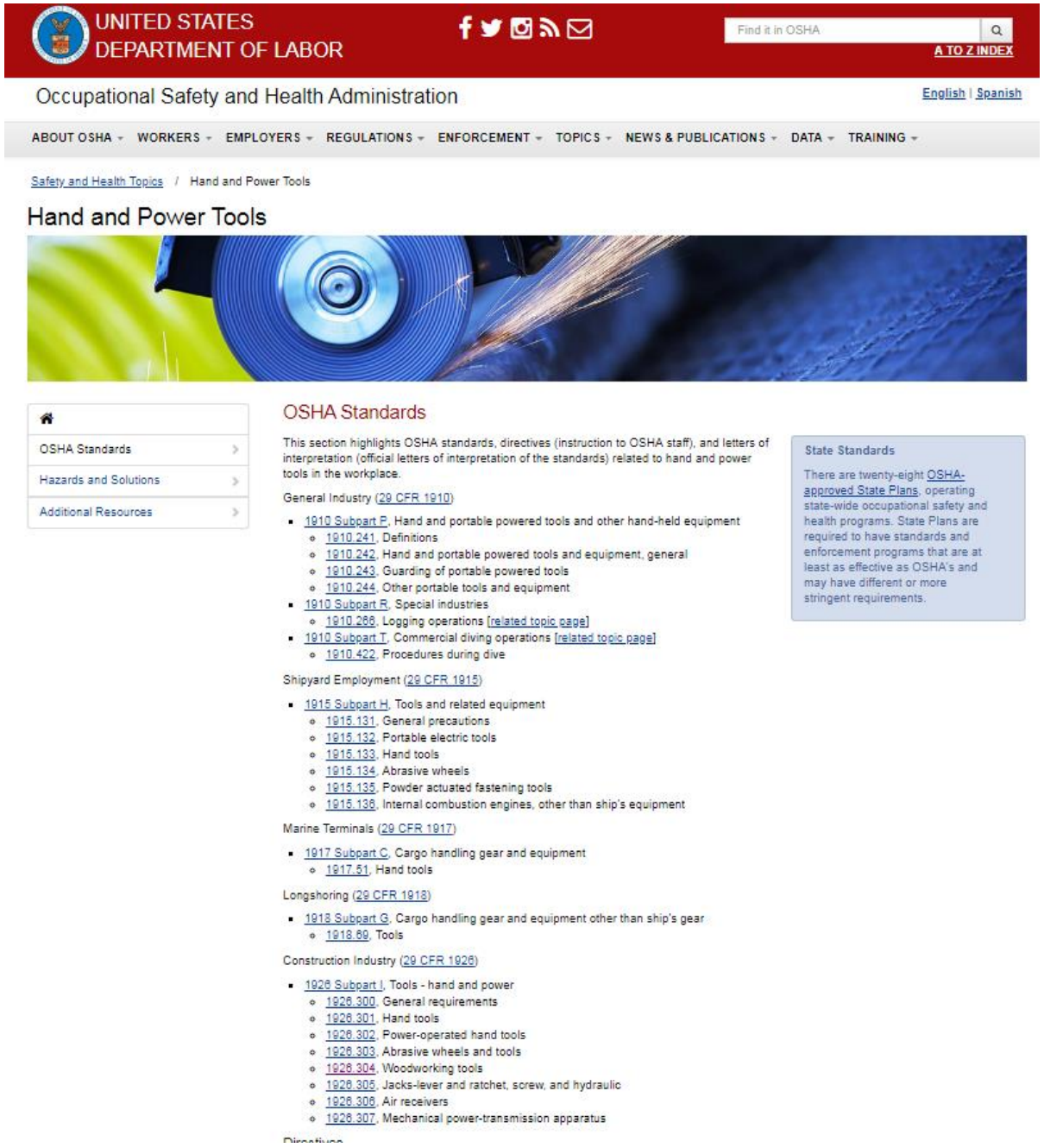


OSHA Standards:

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

Claim Review and Considerations for Adjusters and Case Managers

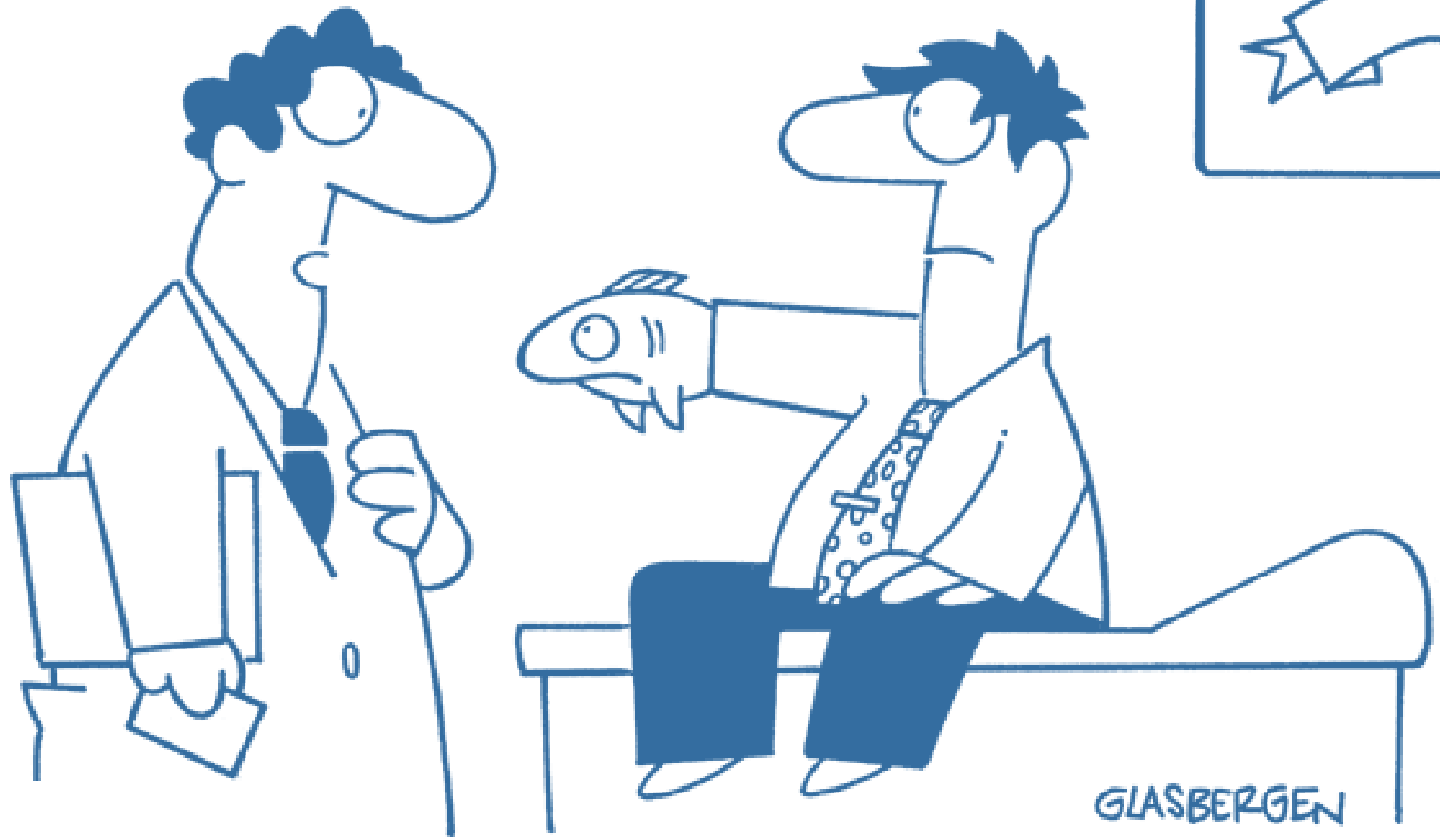
- Confirm demographics of injured worker
- Determine extent of Injuries, treatment to date, lost time.
- Language, transportation issues.
- Pre-existing injuries, co-morbidities.
- Channel into preferred medical network.
- Transitional Duty availability at the employer?

In Summary

- more than 1,000,000 U.S. workers receive treatment in EDs for acute hand injuries.
- BLS estimates that approximately 110,000 workers with hand and finger injuries lose days away from work annually
- Injuries result from both overuse and traumatic/acute conditions
- Common MSDs of the UE involve: Carpal tunnel syndrome, Nerve Compression, Tendonitis, Tenosynovitis, Strains / Sprains & Thoracic Outlet Syndrome
- Common traumatic injuries to the UE involve Skin Contusions, Punctures, Lacerations, Burns & Tendon Rupture

In Summary

- Carpal tunnel presents less than 1% of all UE injuries reported in 2016
- Lacerations present 11.4% of all workplace injuries in private industry
- Best practice to prevent injury is to use properly safety equipment & be aware of possible risk of the job requirement
- Gloves provide hand protection but increase hazards if not fitted or used properly.
- OSHA regulations related to hand safety help reduce the incidence of work related hand trauma.



"Carp tunnel syndrome."

THANK YOU

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In the Corporate/Industrial Setting Athletic Trainers:

Texas Wesleyan University
Athletic Training Education

- 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

NATA
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