



UNIVERSITY OF COLORADO COLORADO SPRINGS

# Laboratory Ergonomics

## University of Colorado Colorado Springs

***Department of Environmental Health and  
Safety***



University of Colorado  
Colorado Springs

# TODAY'S TRAINING

- Define Ergonomics
- Anatomy & Physiology
- Risk Factors in the Laboratory
- Injury Prevention
- Laboratory Demonstration

# THE GOAL OF ERGONOMICS

- **Employee Health & Safety**
- **Employee Awareness**
- **Injury Prevention**
- **Regulatory Compliance**

# WHY ERGONOMICS?

**Because...**

**“Work-related musculoskeletal disorders (WMSDs) are the single largest job-related injury and illness problem in the United States.”**

– Occupational Safety and Health Administration (OSHA) November 14, 2000

Worker’s compensation claims from ergonomic injuries represent an estimated \$20 billion a year in lost-time compensation costs alone.

Total costs are estimated to be \$120 billion annually when lost productivity and other indirect costs are considered.

- *Division of Safety, National Institutes of Health, "A Manual for the Identification, Evaluation and Control of Ergonomic Hazards in the Laboratory," 1998, p.1*

# CUMULATIVE TRAUMA DISORDERS (CTDs)

## Synonymous Terms

**Work-related Musculoskeletal Disorders (WRMSD)**

**Repetitive Motion Injuries (RMI)**

**Repetitive Strain Injury (RSI)**

- Injuries that occur over a period of time
- Disorders of the muscle-tendon unit, peripheral nerves or vascular system
- Caused, precipitated and/ or aggravated by repeated and sustained exertions or motion of body parts, particularly the hands, wrists, elbows, arms, shoulders, neck and back

# CTD RISK FACTORS

- Improper Equipment - Furniture and tools not suited to the task or the individual. Examples:
  - Poor condition
  - Improper placement
  - Incorrect use
  - Incorrectly installed/sized/adjusted
  - Manual rather than powered equipment for large tasks
  
- Repetition - Repeated performance of tasks in a time period that not allowing for full physical recovery. Examples:
  - Pipetting
  - Microscopy
  - Cryostat

# CTD RISK FACTORS

- **Muscle Strain/ Fatigue - Pain/stiffness in muscle tissue, often in**
  - Arm**
  - neck**
  - Back**
  
- **Eye Strain**
  - Blurred vision**
  - Eye pain**
  - Headaches**

# ELEVATED RISK FACTORS FOR LABORATORY PERSONNEL USING PIPETTES

*PIPETTING IS THE #1 CAUSE OF MUSCULOSKELETAL  
DISORDERS IN THE LABORATORY*

## **Risk factors:**

- **Repetition**
- **Force**
- **Contact  
Stress**
- **Posture**

## **Resulting in:**

- **Carpal Tunnel Syndrome  
(CTS)**
- **Tendonitis**
- **Trigger Finger**
- **Tension Neck Syndrome**
- **Others**



# FORCE FROM PIPETTING

A complete pipetting cycle consists of several activities totaling a minimum of 16 kg of force (35 lb) <sup>1</sup>

- Aspiration (3 kgf \*)
- Delivery (4 kgf)
- Tip Mounting and Ejection (9 kgf)  
(Greater insertion forces result in higher ejection forces! )
- Grip - For a pipette without a fingerhook, the force used to grip a pipette must be greater than any force exerted on the pipette, otherwise the pipette would move or fall from the hand.
- Additional Factors - A number of other factors are frequently present (such as poor lighting, stress, inadequate sleep, etc.), further elevating the risk of injury.
  - \* kgf = Kilograms of force

**Pipetting 1000 times in a day, exerts over 35,000 lb of force using just the thumb!**

# INJURIES FROM PIPETTING

- **Study of 128 Laboratory Workers<sup>1</sup>**
  - ❑ 44% reported hand problems
  - ❑ 58% reported shoulder problems
  - ❑ 44% reported neck problems
- **Pipetting Study<sup>2</sup>**
  - ❑ Significant increases in hand & elbow injuries among pipette users
- **National Institute of Occupational Safety & Health<sup>3</sup>**
  - ❑ “a biomechanical hazard exists from exposure to pipetting operations . . . “

1. MG Bjorksten et al, 1994

2. G. David, P. Buckle, 1996

3. NIOSH 1995

# **SYMPTOMS OF CTDs**

- **Tingling sensation in fingers and hands**
- **Decreased mobility of the fingers, hands, elbows or shoulders**
- **Dull, aching discomfort or pain**
- **Decreased hand strength**
- **Numbness**
- **Pain at night/ sleep disruption**
- **Twitching, cysts in the hands and arms**

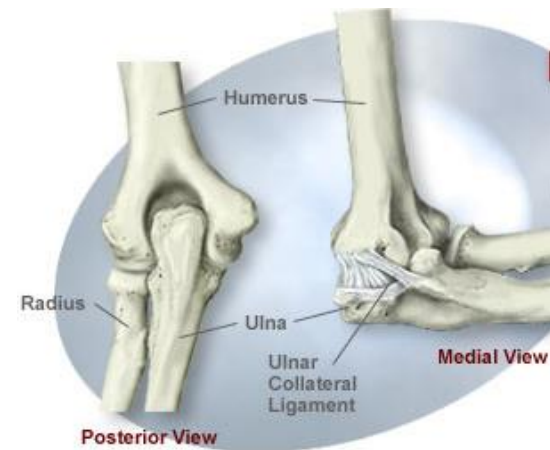
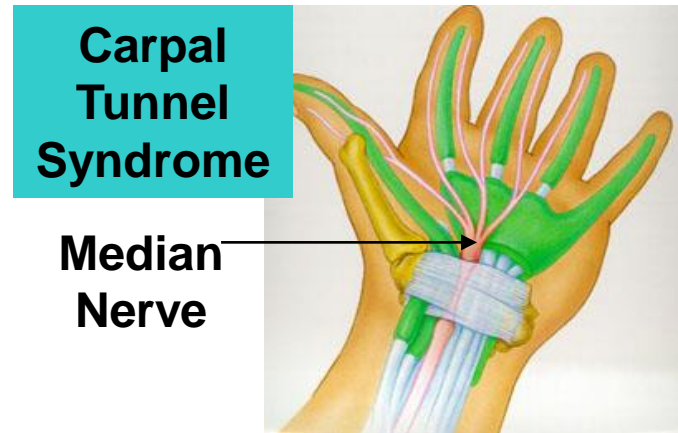
# COMMON ERGONOMIC INJURES

## ➤ Nerve Compression

Can cause pain, numbness, and tingling.

Examples include:

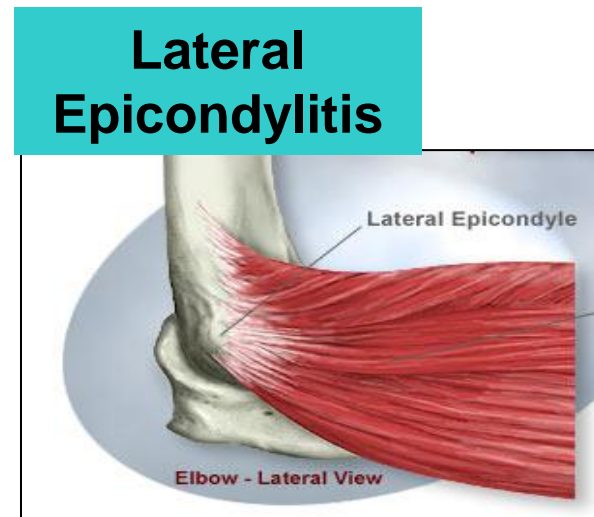
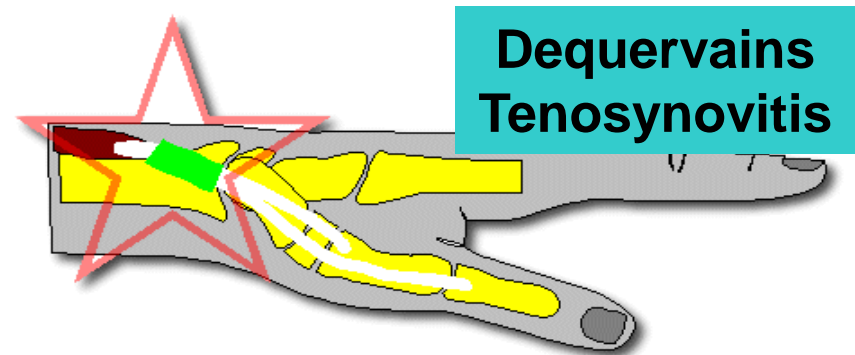
- Carpal tunnel syndrome (wrist)
- Ulnar neuritis (elbow/wrist)
- Pronator syndrome (forearm)



# COMMON ERGONOMIC INJURIES

➤ Tendonitis – Inflammation and pain in the tissue that connects muscle to bone. Types include:

- ❑ Tenosynovitis (thumb)
- ❑ Lateral/medial epicondylitis (elbow)



# TYPES OF PIPETTES AVAILABLE



**Electronic Serological**



**Manual Multi-Channel**



**Electronic Single Channel**



**Manual Single Channel**

# WHAT DOES THE TYPE OF PIPETTE MEAN?

## Hand Posture



### “Clenched Fist”

Increases stress,  
reducing available  
hand strength &  
productivity

### Loose, Relaxed

Increases hand  
strength , endurance  
and productivity



## TRADITIONAL PIPETTES

## ALTERNATE DESIGN

## Wrist Posture



### Over-rotated

Rotation exceeds  
90°, causing  
stress to the wrist,  
hand and elbow

### Neutral, Relaxed

Wrist remains in a  
neutral range of  
motion throughout  
all pipetting  
operations



# WHAT DOES THE TYPE OF PIPETTE MEAN?



## Arm Posture

### “Winged Elbow”

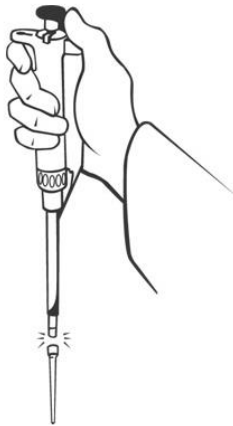
Arm/hand elevation exceeding 12” causes stress to the neck and shoulder

### Elbow Close to Body

Arm elevation remains low, minimizing stress to elbow, shoulder and neck



## TRADITIONAL PIPETTES



## Tip Ejection Method

### Manual Thumb Plunger

Greater force required

### Energy Transfer Button

Releases the tip with minimal effort





# AVOIDING RISKS FROM PIPETTING

- **Rotate pipetting tasks among several people.**
- **Take short micro pauses of a few seconds, when you can't take a longer break.**
- **Use only the force necessary to operate the pipetter.**
- **Choose pipettors requiring the least pressure.**
- **Work with arms close to the body to reduce strain on shoulders.**

# AVOIDING RISKS FROM PIPETTING

- **Keep head and shoulders in a neutral position (bent forward no more than 30 degrees).**
- **Don't elevate your arm without support for lengthy periods.**
- **Use shorter pipettes. This decreases arm and hand elevation and consequent awkward postures.**
- **Use low profile waste receptacles for used tips. They should be no higher than the top of the tubes being filled.**

# RISKY BUSINESS?

Posture and positioning are as important as the tools we choose to use.



# OTHER ERGONOMIC RISKS IN THE LABORATORY



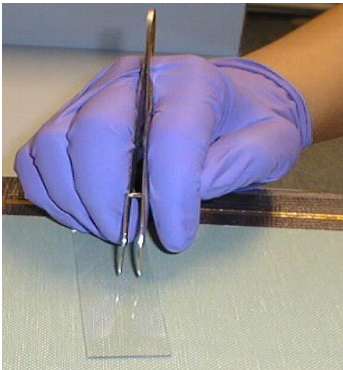
**Cryostats**



**Microscopy**



**Biosafety  
Cabinets**



**Micro-  
manipulation**



**Eye Strain**

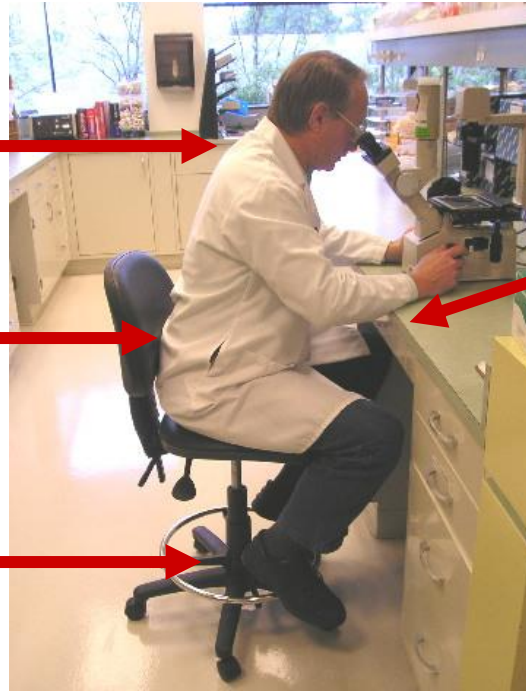
# RISK FACTORS OF MICROSCOPY

**Note shoulder height**

**Weight supported on elbows**

**Unsupported back**

**Foot ring adjustment can force body to be unsupported.**



**Improper seat adjustment**

# AVOIDING RISKS FROM MICROSCOPY

**Note shoulder  
height**

**Back rest adjusted  
forward to support  
back**

**Raised foot rest so  
legs are parallel to  
floor**



**Back  
support  
takes  
weight off  
of elbows**



# AVOIDING RISKS IN THE LAB

## Make Space for Legs Under the Lab Bench



# AVOIDING RISKS IN THE LAB



Avoid contact  
with hard edges



**Padded supports  
help reduce contact  
stress**



**Avoid extending  
arms, keeping them  
close to the body**



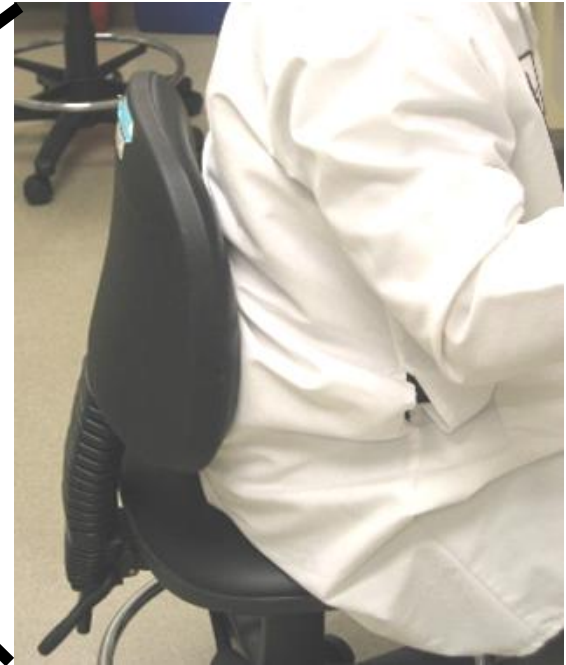
# RISK FACTORS OF THE CRYOSTAT

**Beveled body  
Restricts knees**



**Foot rest  
creates  
distance  
from  
cryostat**

**Design of the machine  
makes it difficult to work  
close to the machine.**



**When feet are  
tucked beneath  
chair, the back is  
not supported**

# AVOIDING RISKS FROM USING THE CRYOSTAT



**When feet are placed outside the unit, the body becomes more balanced**



**Shoulders are relaxed**

**Working close to machine**

**Feet flat on floor**

**The backrest was adjusted so the user can get closer to the machine**

# RISK FACTORS OF BIOSAFETY CABINETS

- Awkward and static posture and positioning
- Constrained body position
- Overreaching



Contact pressure



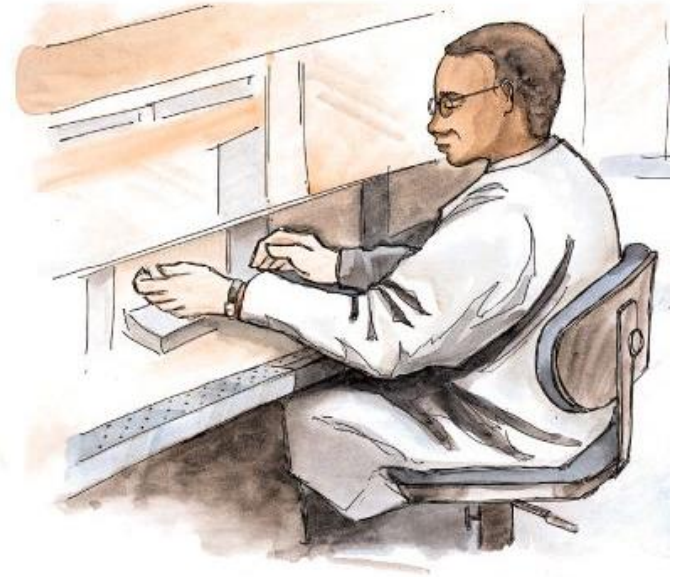
Working with winged elbows



Constrained knee & leg space

# AVOIDING RISKS FROM BIOSAFETY CABINETS

- **Place materials as close as possible**
- **Apply foam padding to the front sharp edge**
- **Use only adjustable chair or stool**
- **Take short breaks to alter repetitive forearm and wrist motions**
- **Raise cabinet upwards for more comfortable leg and thigh clearance.**



# THE LAB STOOL

Risk Factors associated with the lab stool are similar with any other chair.



## Limiting Factors

- Foot Ring
- Back rest range of motion
- Size of seat pan

Adjust the lab stool to support neutral postures and positions

# RISK FACTORS OF EYE STRAIN

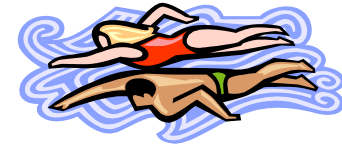
**Eye Strain can result from:**

- **Improper lighting**
- **Glare**
- **Eyewear**
- **Viewing angle and distance**
- **Uninterrupted focus on the screen**
- **VDT and document holder location**
- **Dust on screen**



# INJURY PREVENTION

**Take care of your body!  
Incorporate exercise into  
your daily regimen.**



**Stretch before and during the work  
day!**

**“...the more flexible you are, the  
harder it is for pain & tension to  
lodge in your body.”** Erich Schiffmann



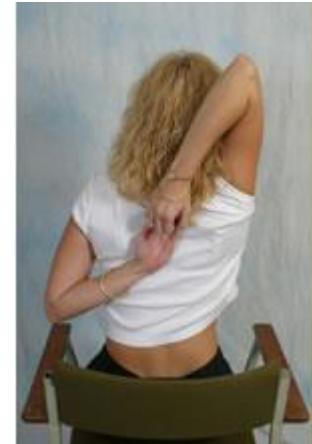
# STRETCHING EXERCISES



## Hand & Wrist Exercises



Sitting hands joined and extended above head, relax the head and gently bend to the left and right, keeping the body straight



**Both hands behind back, one over the shoulder, the other from behind the back, try to link hands. Change sides.**