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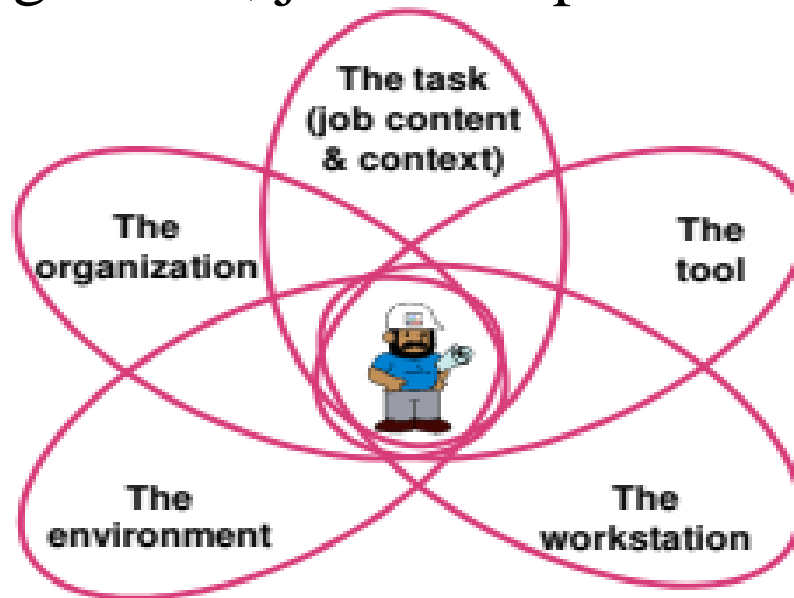
**Introduction to Ergonomics and  
Industrial Safety**  
**Section Four**

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**2012 E.C**

# Ergonomics Hazard and risk Assessment

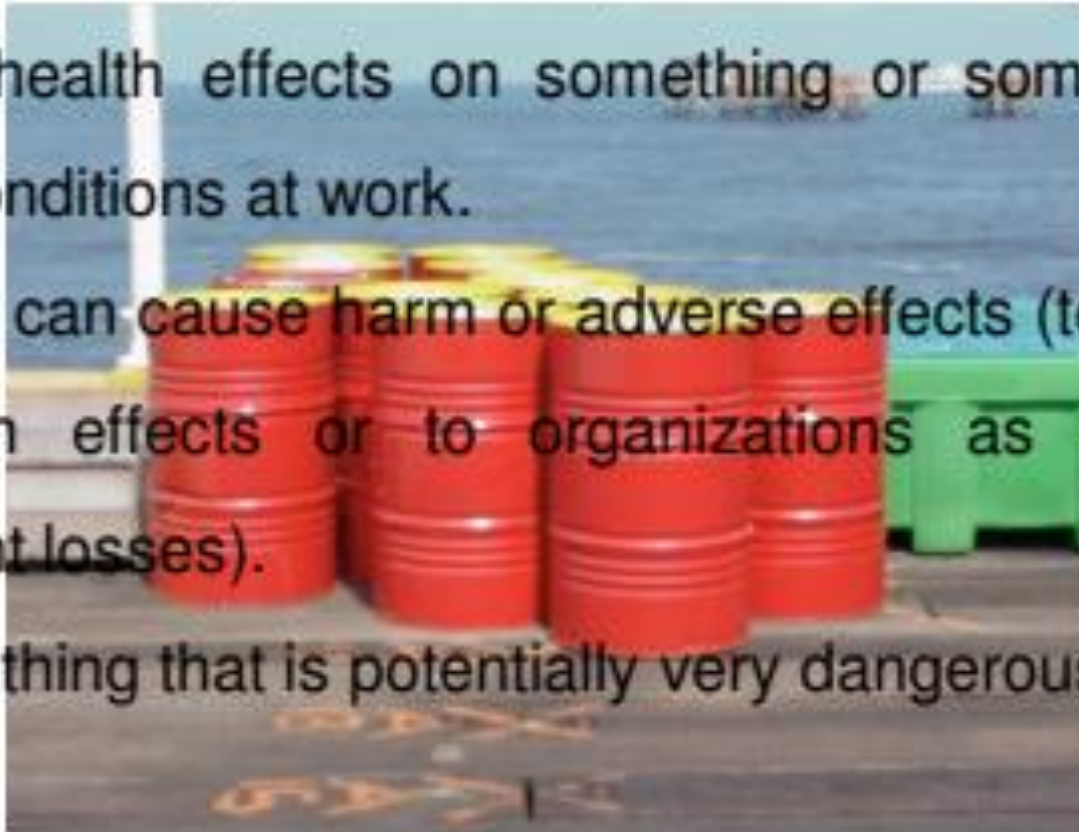
## ERGONOMICS

- ✓ Goal: To reduce work-related musculoskeletal disorders (MSDs) developed by workers.
- ✓ MSDs are injuries and illnesses that affect muscles, nerves, tendons, ligaments, joints or spinal discs.



# HAZARD

- ❖ A **hazard** is any source of potential damage, harm or adverse health effects on something or someone under certain conditions at work.
- ❖ A Hazard can cause harm or adverse effects (to individuals as health effects or to organizations as property or equipment losses).
- ❖ It is something that is potentially very dangerous.



# Exposure

- **Contact** with a Hazard is called **Exposure**
- Exposure is a combination of
  - ✓ Magnitude
  - ✓ Frequency
  - ✓ Duration



# Risk

- It is the probability that a person will be harmed or experience an adverse health effect if exposed to a hazard.
- It is a chance of something going wrong. It may also apply to situations with property or equipment loss.
- RISK occurs only when there is

Hazard



&

Exposure



# Risk Assessment

- **Risk assessment:** In practical terms, a risk assessment is a thorough look at your workplace to identify **those things, situations, processes, equipment's, etc. that may cause harm, particularly to people.**
- Risk assessments are very important as they form an integral part of a good occupational health and safety management plan which helps to:

## Con...

- Create awareness of hazards and risks
- Identify who may be at risk or example employees, cleaners, visitors, contractors, the public, etc.),
- Determine if existing control measures are adequate or if more should be done,
- Prevent injuries or illnesses at the design or planning stage, and
- Prioritize hazards and control measures.

# FIVE STEPS TO RISK ASSESSMENT

- ✓ **Step 1- Look for the hazards.**
- ✓ **Step 2- Decide who might be harmed, and how.**
- Step 3- Evaluate the risks** arising from the hazards and decide whether existing precautions are adequate or more should be done.
- ✓ **Step 4- Record your findings.**
- ✓ **Step 5- Review your assessment** from time to time, **revise it** if necessary and **take corrective action.**



# HAZARDS AT WORKPLACE

- Physical
- Chemical
- Biological and
- Ergonomics



# Con...

<b><i>Workplace Hazard</i></b>	<b><i>Example of Hazard</i></b>	<b><i>Example of Harm Caused</i></b>
Tool	Knife	Cut
Substance	Benzene	Leukemia
Material	Asbestos	Mesothelioma
Source of Energy	Electricity	Shock, electrocution
Condition	Wet floor	Slips, falls
Process	Welding	Metal fume fever
Practice	Hard rock mining	Silicosis

## Con...

- As shown in the table, workplace hazards also include practices or conditions that release uncontrolled energy like:
  - ✓ An object that could fall from a height (gravitational energy),
  - ✓ A run-away chemical reaction (chemical energy),
  - ✓ The release of compressed gas or steam (pressure; high temperature),
  - ✓ Entanglement of hair or clothing in rotating equipment (kinetic energy), or
  - ✓ Contact with electrodes of a battery or capacitor (electrical energy)

## Con...

- ❑ Adverse health effects include:
  - ✓ Bodily injury,
  - ✓ Disease,
  - ✓ Change in the way the body functions, grows, or develops,
  - ✓ Effects on a developing fetus,
  - ✓ Effects on children. (inheritable genetic effects)
  - ✓ Decrease in life span,
  - ✓ Change in mental condition resulting from stress, traumatic experiences, exposure to solvents, and so on, and
  - ✓ Effects on the ability to accommodate additional stress

## Types of Health Effects

- ❑ Musculo-skeletal disorders (MSD)
- ❑ Cumulative trauma disorder (CTD)
- ❑ Carpel tunnel syndrome (CTS)
- ❑ Backache/back strain/neck strain
- ❑ Repetitive strain injuries (RSI)

# Musculoskeletal disorders (MSD)

- MSDs are illnesses and injuries that affect one or more parts of the musculoskeletal system.
- They include sprains, strains, inflammation, tears, pinched nerves or blood vessels, bone splintering and stress fractures (a tiny break in a bone caused by excessive force).
- A pinched nerve is caused when a nerve is somehow damaged or injured by direct pressure or compression and is unable to properly conduct its signal. There are many potential causes for a pinched nerve, depending on the location of the nerve.

## Con...

- A **sprain** is an injury in a joint, caused by the ligament being stretched beyond its capacity.



Musculoskeletal disorders occur in every kind of occupation and industry

## Common Symptoms of MSDs

- ❖ Painful joints
- ❖ Pain, tingling, numbness in hands, wrists, forearms, shoulders, knees and feet
- ❖ Shooting or stabbing pains
- ❖ Swelling or inflammation





## Con...

- Fingers or toes turning white
- Back or neck pain
- Stiffness



Low  
Back  
Pain



Neck Pain



# Cumulative trauma disorder (CTD)

- NIOSH has ranked the occupational injuries and diseases in according to their frequency, severity, and possibility of prevention .
- *Cumulative trauma disorders* (sometimes called ***repetitive motion injuries, or work-related musculoskeletal disorders***) are injuries to the musculoskeletal system that develop gradually as a result of repeated micro-trauma due to poor design and the excessive use of hand tools and other equipment.
- Because of the slow onset and relatively mild nature of the trauma, the condition is often ignored until the symptoms become chronic and more severe injury occurs

Con...

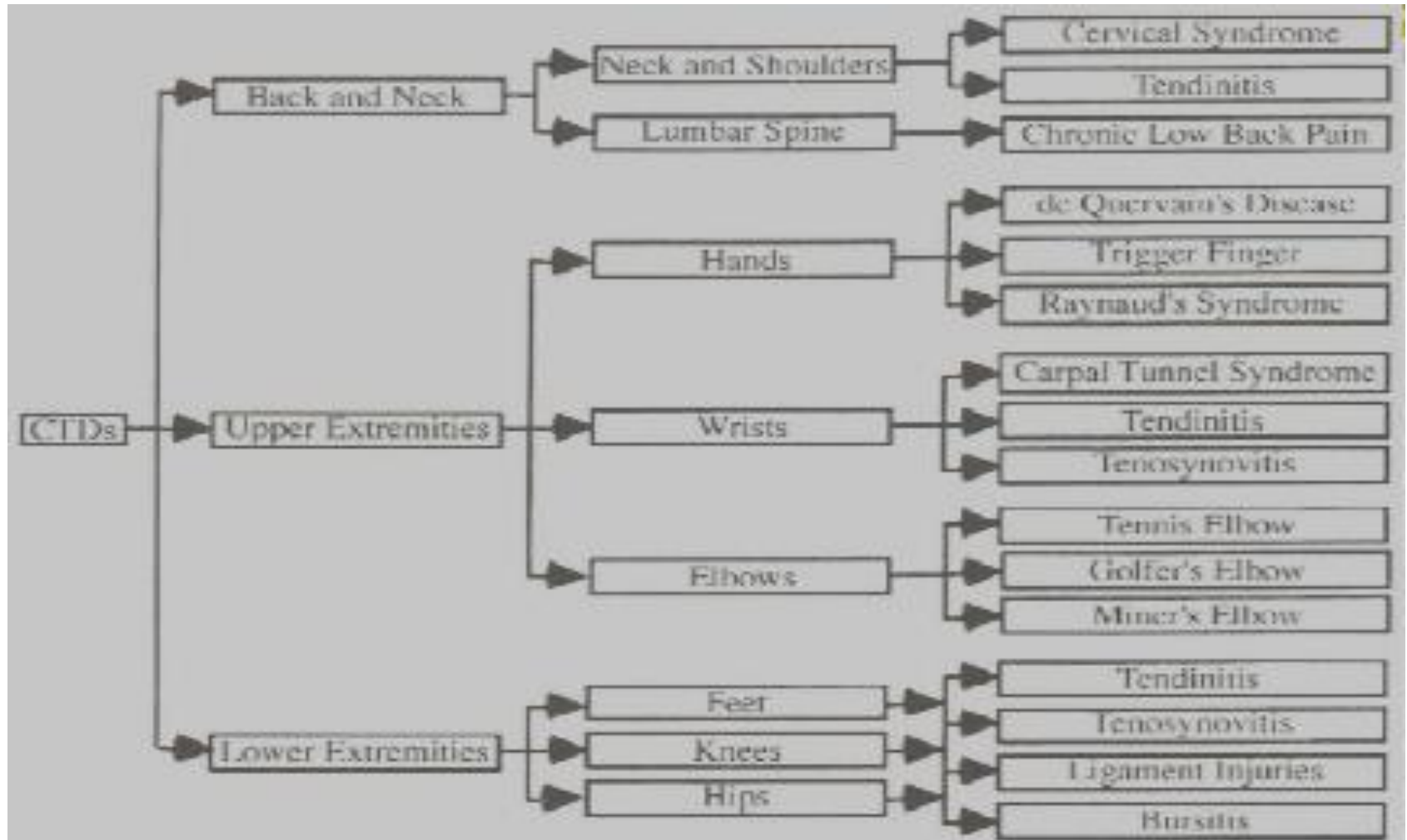
- They are a collection of a variety of problems, including repetitive motion disorders, carpal tunnel syndrome, tendinitis, ganglionitis, tenosynovitis, and bursitis, with these terms sometimes being used interchangeably.
- **Bodily injuries** or physical ailments that have **developed gradually** over periods of weeks, months, or even years as the result of **repeated stresses** on a particular body part

## Common body parts affected by CTDs

- Back and Neck CTDs affect: Neck and shoulders, Lumbar spine
- Upper extremities affect: Hands , Wrists, Elbows
- Lower extremities affect: Feet, Knees and hips

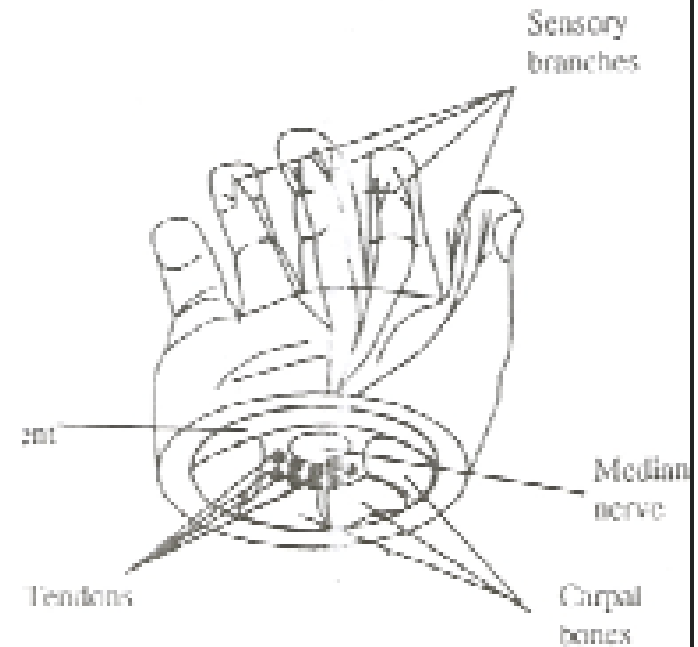


Con...



# Carpel tunnel syndrome (CTS)

- The movements of the human hand are accomplished by two sets of muscles and tendons: the **flexors**, for bending the fingers and thumb, and the **extensors**, for straightening out the digits. `
- Due to its wide spread development , a special emphasis is placed on carpal tunnel syndrome (CTS)



## Con...

- Complete interruption of the median nerve results in an inability to pronate the forearm or bend the hand in a radial direction and In paralysis of flexion of the index finger and terminal phalanx of the thumb.
- The increase pressure in the bony tunnel can trap and/or pinch the median nerve, causing occasional numbness, pain and scratchy in the thumb, index, and middle fingers. This conditions is called CTS.

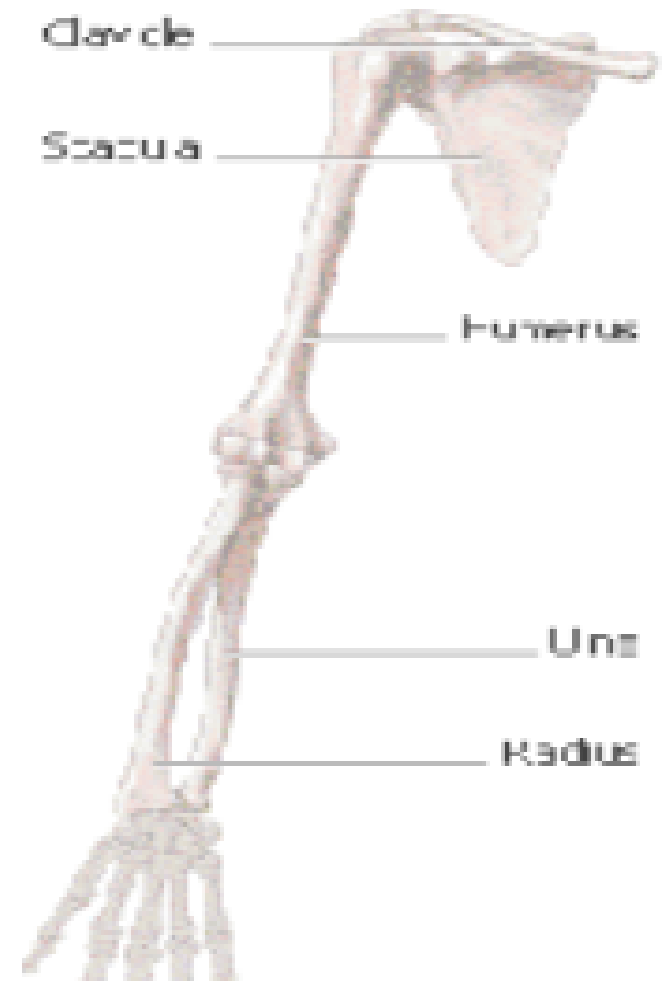
# Structure and Function of the Musculoskeletal System

- ❑ Three most commonly injured parts – Hand, Arm , Spinal column
- ❖ The hand has 27 bones:
  - ✓ The 8 bones of the carpus, or wrist, arranged in two rows of four;
  - ✓ The 5 bones of the metacarpus, or palm, one to each digit; and
  - ✓ The 14 digital bones, or phalanges, 2 in the thumb and 3 in each finger
  - ✓ The carpal bones fit into a shallow socket formed by the bones of the forearm



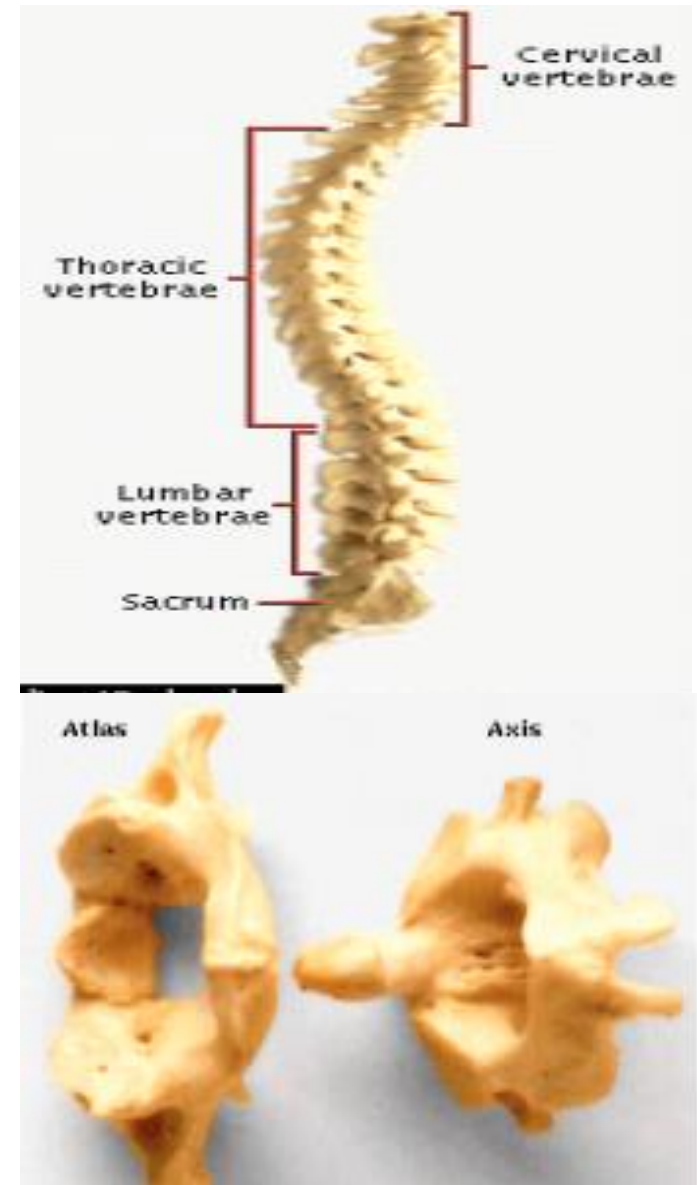
# Arm

- ✓ The arm extends from the shoulder to the wrist. The upper arm is formed by one long bone, the humerus.
- ✓ The two bones of the forearm are the radius and the ulna. The ulna is fixed in position, but the radius can rotate over the ulna.
- ✓ Together the biceps and triceps muscles control most of the movements of the arm.
- ✓ The axillary artery is the primary vessel that supplies the upper arm with blood



# Spinal Column

- It is also called a vertebral column, spine, or backbone (S-shaped).
- It forms the major part of the skeleton. It attached the skull, shoulder bones, ribs, and pelvis.
- The spinal column contains 33 vertebrae: 7 cervical vertebrae in the neck; 12 thoracic, or dorsal, vertebrae in the region of the chest, or thorax, providing attachment for 12 pairs of ribs; 5 lumbar vertebrae in the small of the back; 5 fused sacral vertebrae forming a solid bone

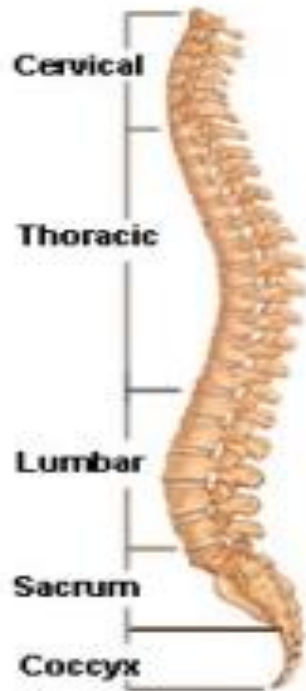


## Cause of back injuries

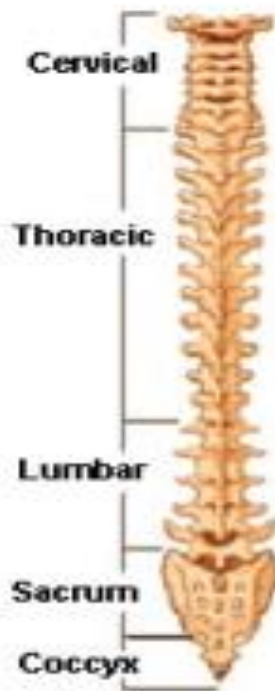
- Most low-back problems are due to damage to the lumbar inter-vertebral disks to degenerative disk disease.
- For unknown reasons, Inter-vertebral disks may degenerate and lose their strength. This process is characterized as follows:
- Degenerated disks allow tissues and nerves to be strained and pinched, leading to back pain, and even in severe cases to paralysis of the legs

Con...

Lateral (Side)  
Spinal Column



Posterior (Back)  
Spinal Column



Normal curvature



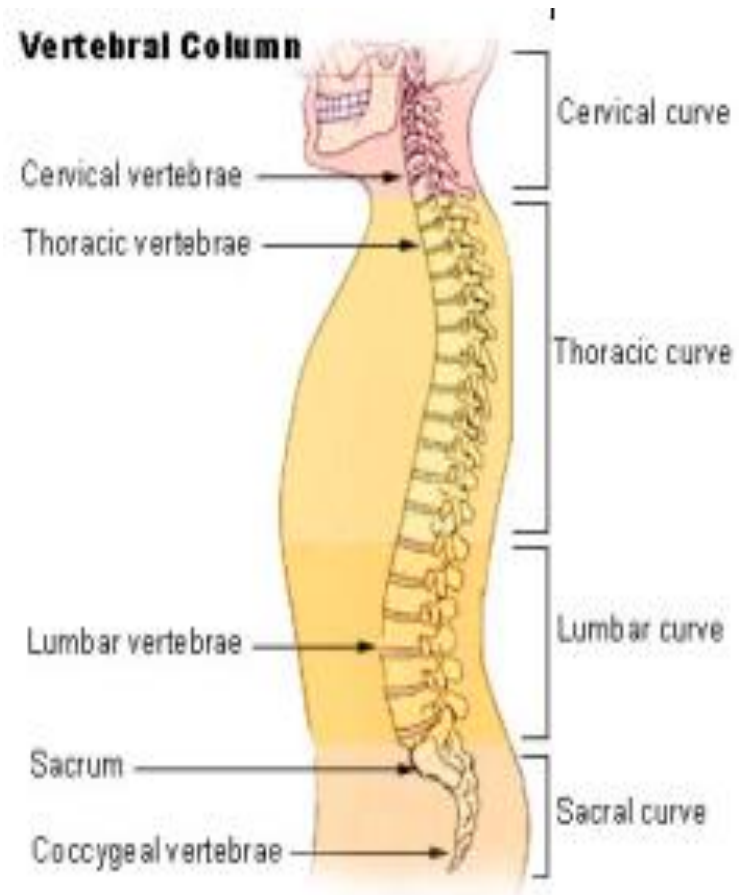
Abnormal curvature

## Back-injury prevention

- ❑ Recommendation for working at a seated & standing workstation
- Static posture should be frequently changed or interrupted.
- Exercise for restoring flexibility and physical fitness are highly recommended.
- Proper working posture and material handling should be followed

# The neck and neck problem

- The cervical spine can be characterized as follows
  - It consists of the top seven vertebrae of the spinal column
  - It is very mobile
  - It exhibits a lordosis (forward curvature) when standing upright.



# Properties of Musculoskeletal Disorders

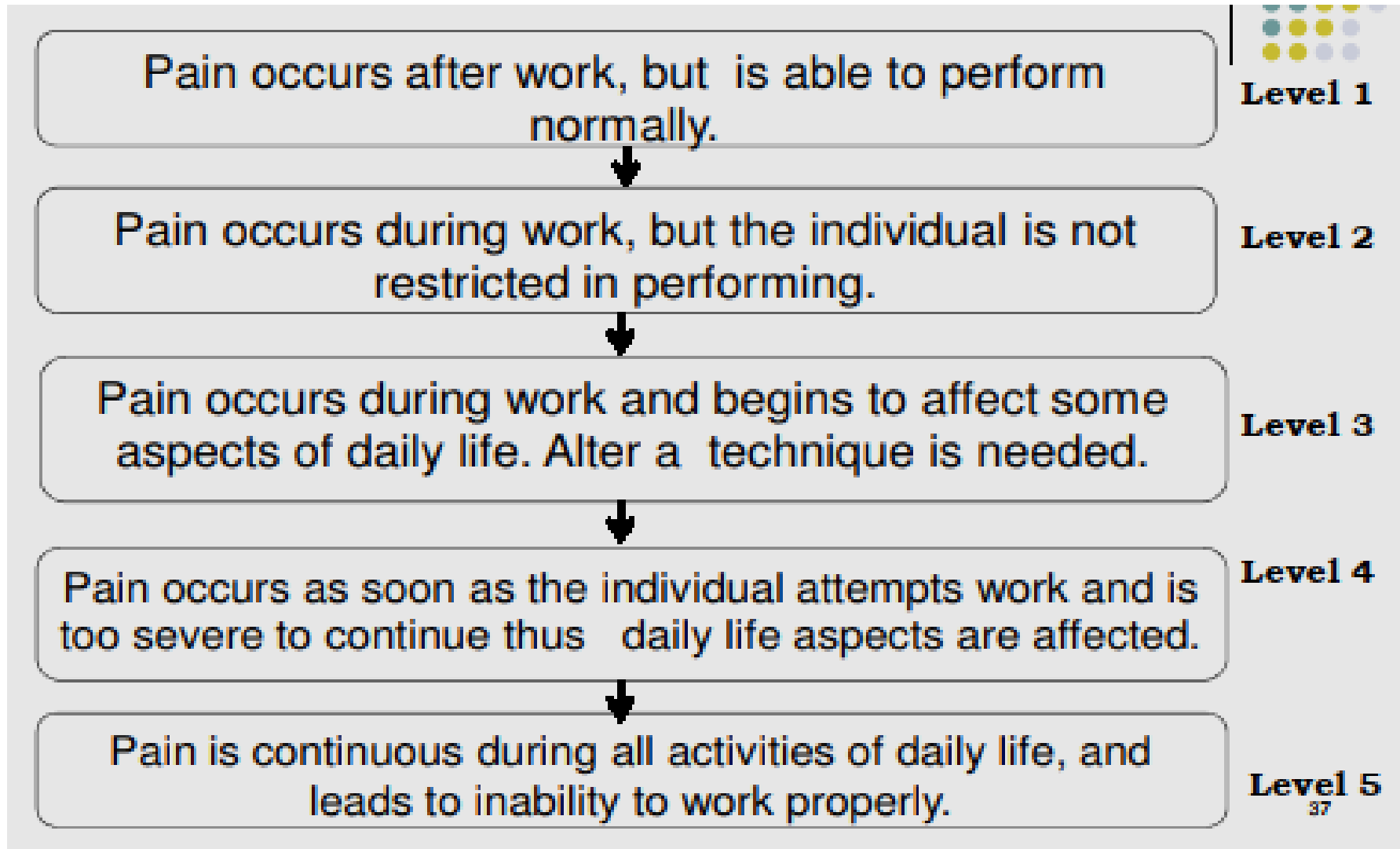
- ✓ Related to work intensity and duration.
- ✓ Require periods of weeks, months or years to develop.
- ✓ Require periods of weeks, months or years for recovery.
- ✓ Poorly localized, nonspecific and periodic.  
Often unreported.
- ✓ Mechanical and physiological process.
- ✓ Multiple work and personal causes.

## How do I know if I have MSD?

- ✓ You could have a work-related MSD if you experience any of the following:
  - ❖ Swelling, Redness, Difficulty moving a particular joint,
  - ❖ Numbness, itchy, Pain
    - Numbness in your fingers,
    - Numbness in your thighs,
    - Difficulty moving your finger,
    - Stiff joints, or
    - Back pain



# Progression of MSD signs and symptoms in workers



# Ergonomic factors for workplace hazard

- ❑ Working postures / chairs
- ❑ Space per work shift
- ❑ Working surface height
- ❑ Reach / machine feeding
- ❑ Space between machines
- ❑ Strenuous physical load



## Con...

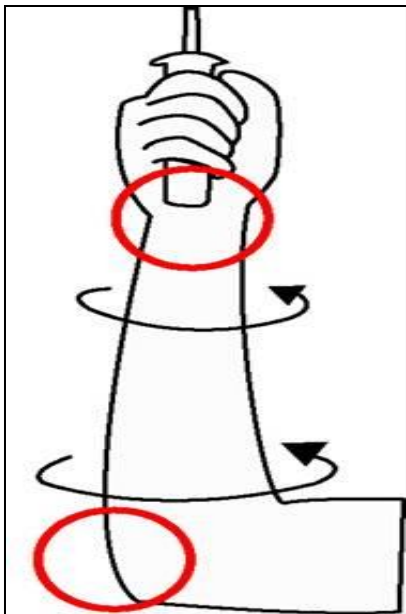
- ❑ Lifting heavy loads/frequent bending/repetitive & monotonous work
- ❑ Design of tools
- ❑ Displays and instructions
- ❑ Mental overload / visibility/

## **Risk Factors that Lead to MSDs**

1. Repetitive motions
2. Forceful exertions
3. Awkward postures
4. Contact stress (pressure points)
5. Vibrations
6. Using tools not ergonomically designed

# Repetitive Motion

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



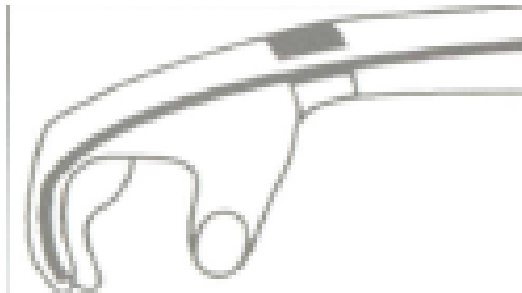
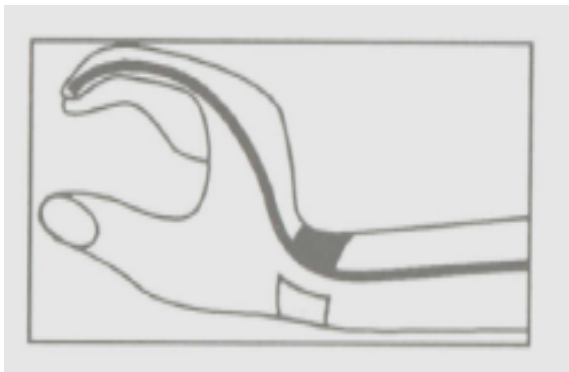
## Forceful Exertions

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



# 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

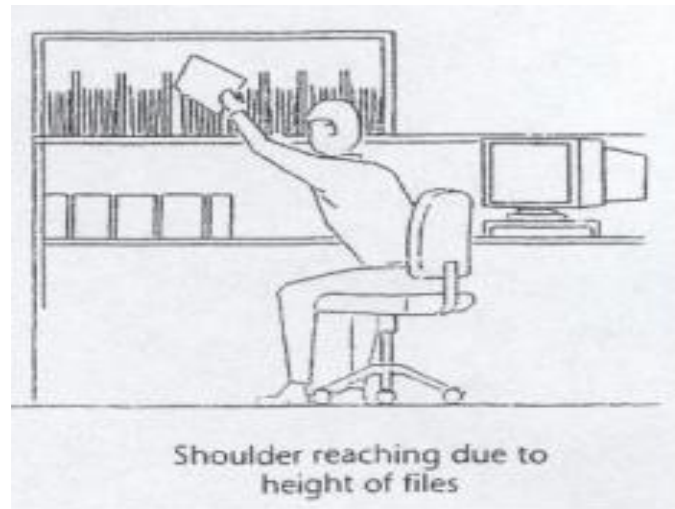


When the wrist is bent (a) dorsally or (b) Palmarly

# Awkward Postures Typical of Office Work



Can cause neck pain and shoulder pain, both sides.



Be cautious of twisting and bending, stand up and use good body mechanics.



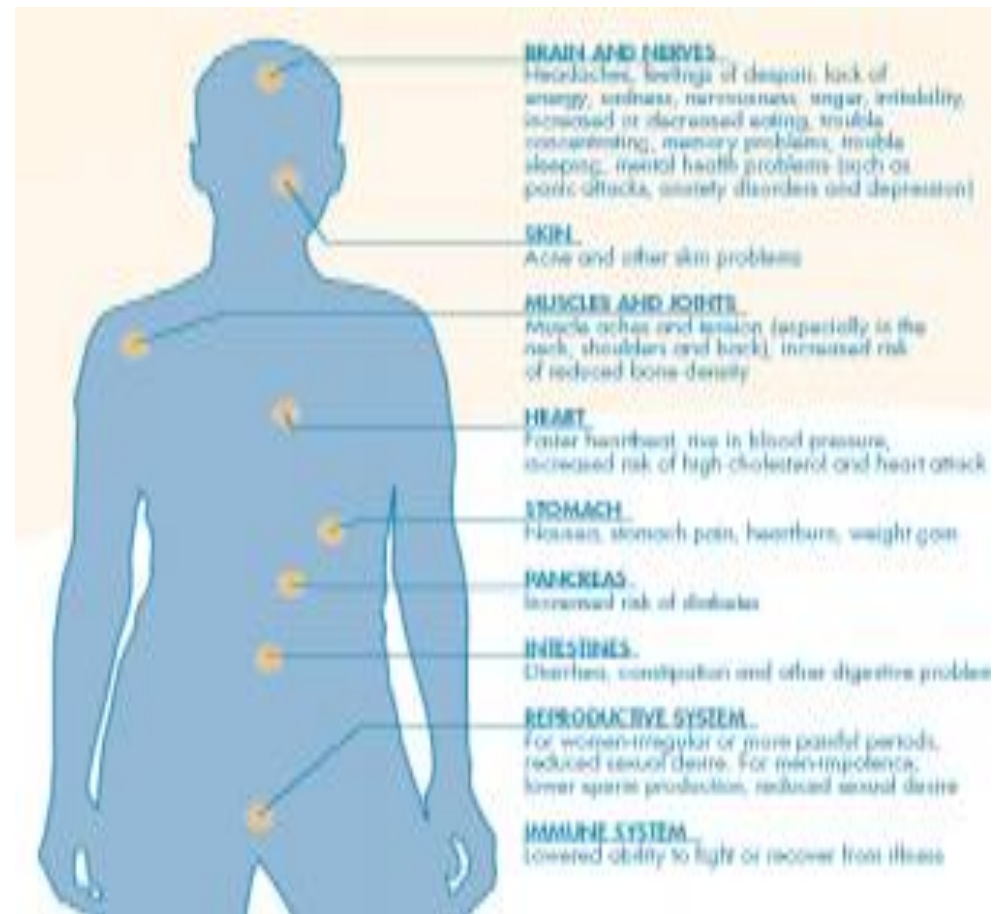
Stand up, don't reach for items.



# STRESS

- The harmful physical and emotional responses that occurs when the requirements of the job do not match the capabilities, resources or needs of the worker.

## STRESS: Effects



# 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

## Facts about MSD

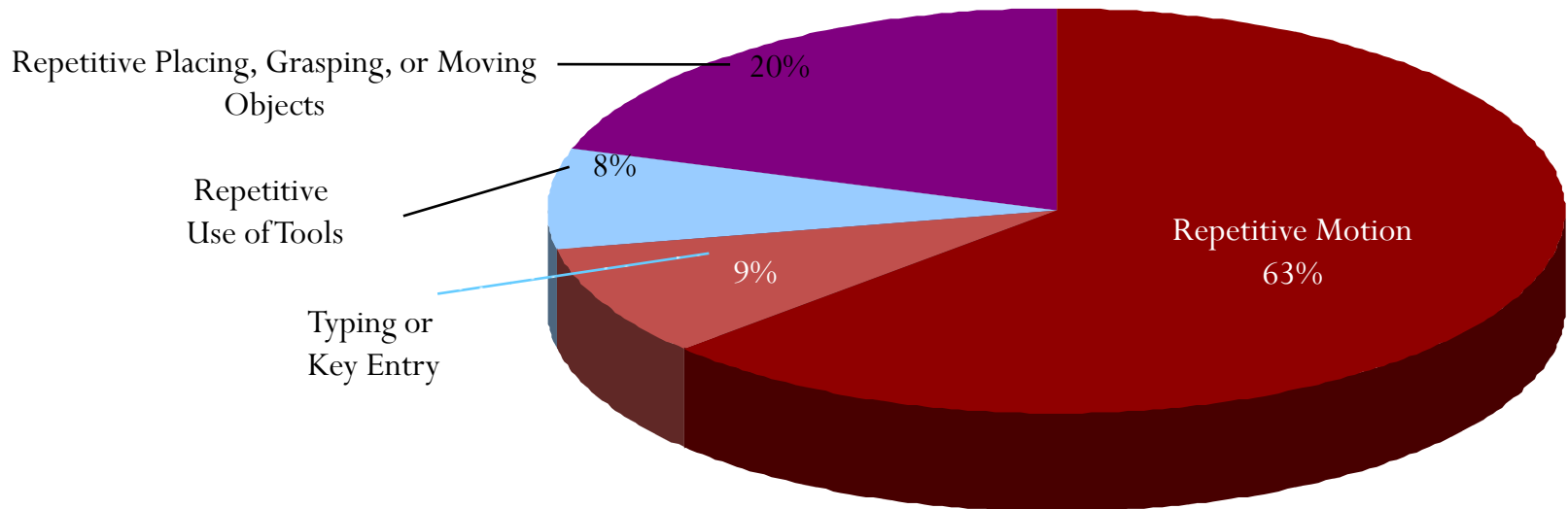
1. They affect your *musculoskeletal system* - your muscles, nerves, tendons, ligaments, joints, cartilage and spinal discs.
2. They are *cumulative* - they happen gradually, as opposed to accidents.
3. They are *chronic* - the effects last a long time.

## How MSDs differ from injuries and fatigue ?

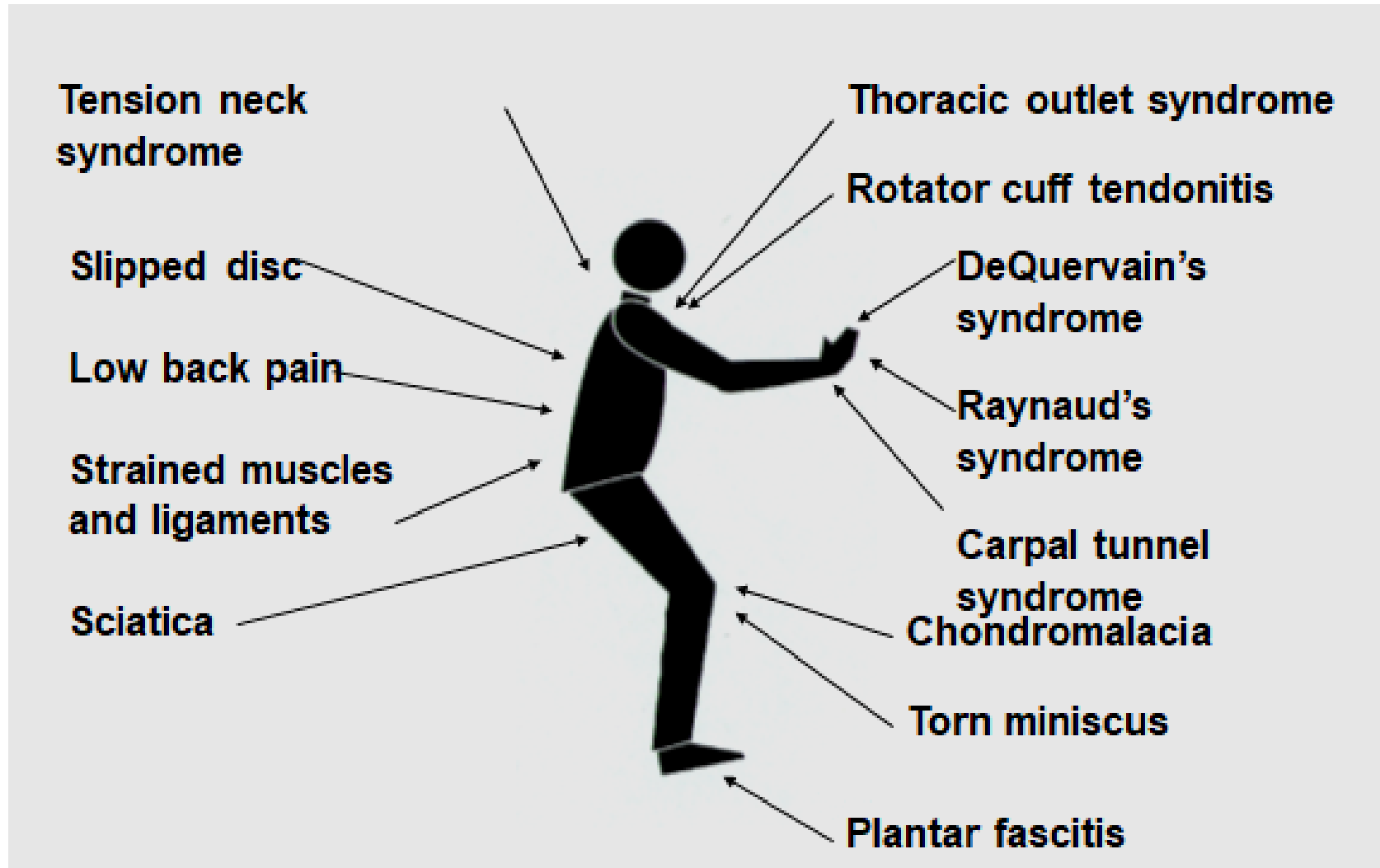
Injuries & fatigues		MSDs
1	Caused by sudden trauma	Caused by cumulative trauma
2	Develop Quickly	Take long time to develop
3	Require few days for recovery	Requires longer time of recovery

# 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



# MSDs (Musculoskeletal Disorders)



# MSD Symptoms

- **Back and neck**— shooting pain, stiffness
- **Shoulders**—pain, stiffness, loss of mobility
- **Arms and legs**— shooting pains, numbness
- **Elbow and knee joints**— pain, swelling, stiffness, soreness
- **Hands and wrists**— swelling, numbness, loss of strength
- **Fingers**—jerking movements, or loss of strength, mobility, and feeling
- **Thumbs**—pain at the base
- **Feet and toes**— numbness, tingling, stiffness, burning sensation

# Prevention of MSD related Problems

MSD prevention is based on two levels of approaches:

I. Control the risk factors and

II. Recognize and respond to early signs and symptoms.

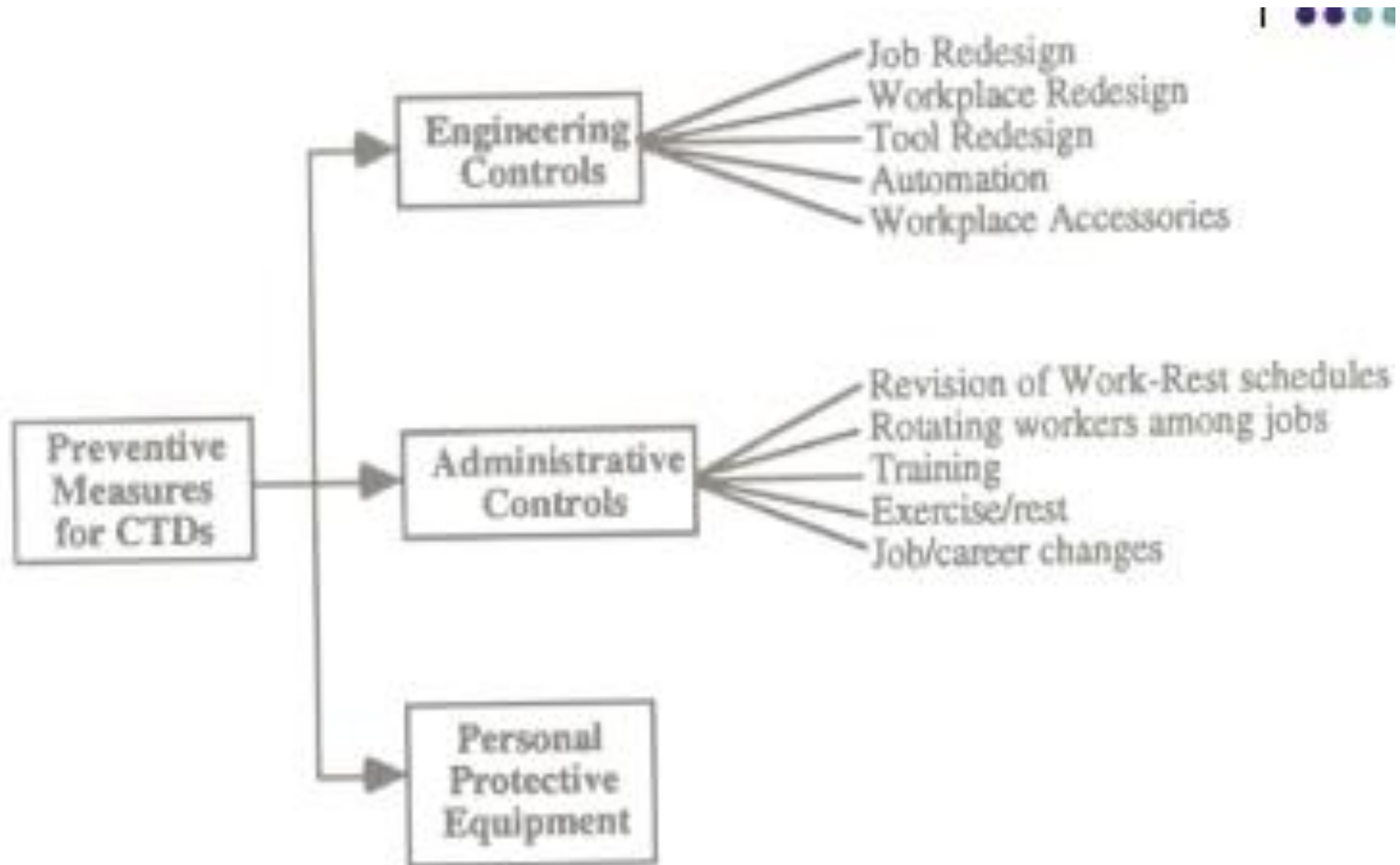
Prevention measures that minimize the risk of CTDs may be grouped into the following three categories:

1- Engineering solutions

2- Administrative controls; and

3- Personal protective equipment

# Con...



A schematic illustration of preventive measures for cumulative trauma disorders (CTDs)



# I. Controlling risk factors

## 1- Engineering controls:

- ✓ Engineering solutions are based upon ergonomic principles which are used to analyze repetitive motion tasks, identify the stressful ones, and reduce such stressors.
- ✓ For example, workstations, work-tools and work methods can be modified to eliminate repetitive movements, excessive forces and/or awkward postures

# Con...

## A- Job redesign :

- The jobs performed by workers in a problem area should be investigated to pinpoint job elements which may be responsible for problems. Some repetitive tasks may not be necessary at all, and should be eliminated.

**Following ergonomics guidelines should be considered in job design & job modification:**

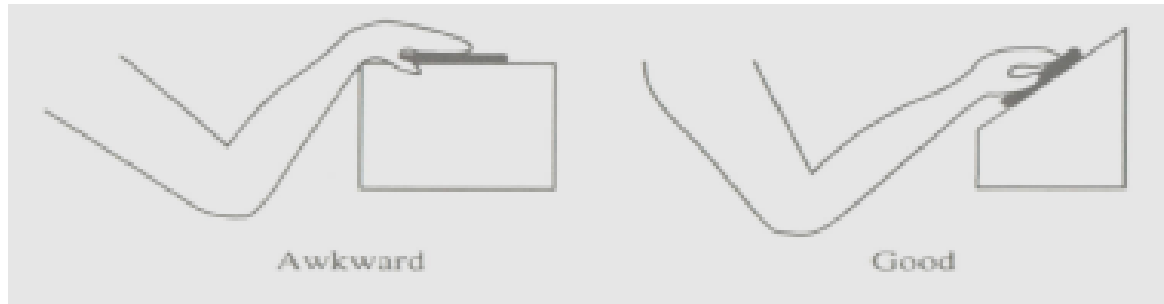
All repetitive tasks performed in awkward postures or that require excessive exertion should be eliminated. Avoid keeping the same posture, even a good posture, for too long. Allow and encourage postural changes. Minimize pinch grips. Use the whole hand as much as possible when grasping is required.

## Con...

- ✓ Hold an object near its center of gravity, so that its weight is balanced.
- ✓ Avoid activities requiring excessive forces. Try to minimize lifting, pushing, pulling, and grasping.
- ✓ Avoid tasks requiring the same movements repeated over and over for a long period of time. Frequent rest pause help
- ✓ tensed and fatigued muscles to recover their normal effectiveness.
- ✓ Minimize exposure to vibration and cold temperatures.
- ✓ Frequent movements become much riskier if they are combined with poor postures & excessive force.

## B- Workplace redesign

- In appropriately designed workstations force workers to assume awkward postures affecting the back, neck



- ❖ Some guideline for work station design redesign are
  - ✓ Correct working posture
  - ✓ Elimination of extended reach
  - ✓ Adjustable working stations for different workers

# Con...

**C- Tool and equipment redesign:** When multiple workers use the same workstation and equipment, the equipment should be adjustable.

**D- Workplace accessories:** A great number of ergonomics products are marketed that seem to be useful for minimizing the risk of developing musculoskeletal disorders.

- ❑ Two general classes of such products are
  - ✓ Computer accessories :- Mouse pads nests, wrist rests, footrests, armrests, document holder and keyboard holder/trays
  - ✓ Floor covering : mats

## 2- Administrative controls

- ❑ It Reduce exposure to the hazard by controlling behaviors through design of safety rules and safe work practices and procedures as:
  - ✓ Revision of work rest schedule
  - ✓ Broadening or varying the job content
  - ✓ Training in the recognition of risk factors
  - ✓ Adjusting the workplace
  - ✓ Reducing shift length or curtailing the amount of overtime
  - ✓ Scheduling more breaks
  - ✓ Rotating workers among jobs

### 3. Work Practice Controls

- ✓ Are behavior-based controls that change the manner in which a job is performed
- ✓ Procedures for safe and proper work that are understood and followed by managers, supervisors and employees
- ✓ Examples of work practice controls for MSD hazards include:

*Safe work techniques and procedures*

*Conditioning period for new or reassigned employees*

*Training in the recognition of ergonomic hazards*

*Training in work techniques that reduce MSD hazard*

# Ergonomic Chair



- ❑ Seat height adjustable.
- ❑ Back adjustable up and down.
- ❑ Back tilt forward and back.
- ❑ Seat pan adjustable in and out.
- ❑ Arms adjustable up and down (arms optional).
- ❑ Proper fit for individual.
- ❑ 5 casters for stability



## Sitting Posture

- Sit close to your desk so you don't have to bend forward.
- If you do bend, bend from your hips.
- Position your work or chair so you can look forward rather than down.
- Use a document holder or move your computer screen so the top of it is at eye level.
- Shift your position frequently to prevent strain.
- Take a break or do stretching exercises

## Exercises – Knee Kiss

- Pull one leg to your chest, grasp with both hands and hold for a count of five.
- Repeat with the opposite leg.



## Exercises - Windmill

- ✓ Place your feet apart on the floor.
- ✓ Bend over and touch your right hand to your left foot, with your left arm up.
- ✓ Repeat with opposite arm



## Exercises– Back Relaxer

- Bend down between your knees for as long as you can.
- Return to upright position, straighten and relax



## Exercises – Pectoral Stretch

- Grasp your hands behind your neck and press your elbows back as far as you can.
- Return to starting position, then drop your arms and relax.



## Exercises – Middle/Upper Back Stretch

- Raise your right arm and grasp it below the elbow with your left hand.
- Gently pull your right elbow toward your left shoulder as you feel the stretch.
- Hold for five seconds.
- Repeat with left arm.



## Exercises – Side Stretch

- ✓ Interlace your fingers and lift your arms over your head, keeping your elbows straight.
- ✓ Press your arms backward as far as you can.
- ✓ Slowly lean to the left and then to the right until you can feel the stretching



## Exercises – Finger Stretch

- With palms down, spread your fingers apart as far as you can.
- Hold for the count of five.
- Relax and then repeat.

**7**

**Fingers.** With palms down, spread your fingers apart as far as you can. Hold for the count of five. Relax. Repeat.





## Exercises – Shoulder Roll

- Slowly roll your shoulders forward five times in a circular motion using your full range of motion.
  - Then roll your shoulders backward five times with the same circular motion



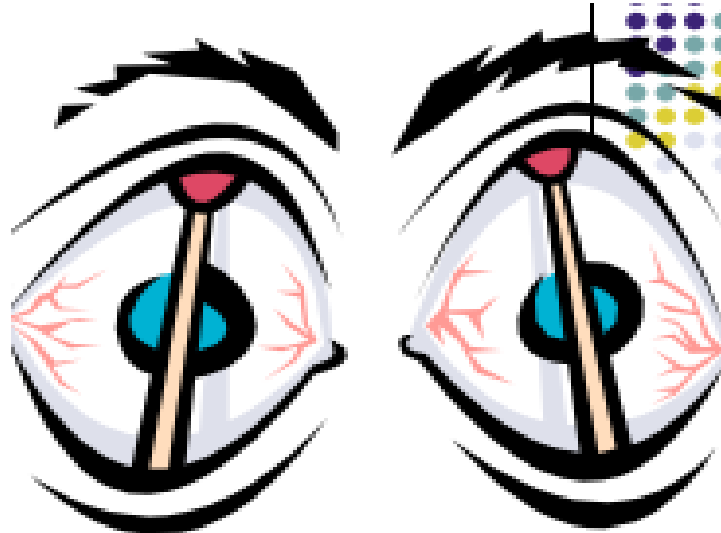
**Shoulder Roll.** Slowly roll your shoulders forward five times in a circular motion, using your full range of motion. Then roll your shoulders backward five times with the same circular motion.



## Exercises EYE

- Eye comfort exercises
- ✓ Blinking
- ✓ Yawning
- ✓ Focus change

Blinking and Yawning both produce tears to help moisten and lubricate the eyes. Focus on a distance object across the room or even outside the window.



# EYE Palming

- While seated, brace elbows on the edge of the desk
  - Let weight fall forward
  - Cup hands over eyes and close eyes
  - Inhale slowly through nose & hold for 4 seconds
  - Continue deep breathing for 15-30 seconds



# NECK STRETCH

- ❑ Tilt ear towards shoulder
- ✓ Reach up and touch top of head with palm to hold in tilted position
- ✓ Hold 5-10 seconds. Repeat 2-3 times (come out of stretch slowly)
- ✓ Reverse side and repeat



## Shoulder Pinch

- Place arms behind head being careful not to press hand into head
- Relax shoulders, and squeeze shoulder blades together while keeping shoulders back and down
- Hold 5-10 seconds. Repeat 2-3 times



## Chair Rotation Stretch

- ❑ Sit in chair and place feet flat on floor
- ❑ Reach across your body and grab the back of the chair
- ❑ Pull gently to increase stretch in mid back
- ❑ Hold 5-10 seconds. Repeat 5 times
- ❑ Repeat on other side



## Arms Behind Back Stretch

- ✓ Hold hands behind back and grasp hands together
- ✓ Pull shoulder blades back and down
- ✓ Hold 5 seconds. Repeat 5 times



## Wrist Flexed & Extended

- Hold arm straight at waist height
- With fingers of other hand, gently press down above the knuckles, bending wrist down. (DO NOT hold at the fingers to push down.)
- Hold 5-10 seconds and repeat 2-3 times
- For extending, hold onto palm of hand and stretch wrist back. (DO NOT pull on fingers.)
- Hold 5-10 seconds and repeat 2-3 times



Picture of flexing.

Picture of extending



Thank You!

