Chapter 12: Musculoskeletal Disorders

Learning Outcomes:

After completing and studying this chapter You should be able to:

• Define the term MSD,
• Describe the goals of studying MSD,
• Discuss different approaches to reduce MSD,
• Know the main occupational risk factors for MSD,
• Apply engineering knowledge to minimize MSD,
• Implement ergonomic (engineering, administrative) solution to MSD,
Musculoskeletal Disorders

**Definition:** Intermediate-term (months/years) effects of body activity upon the nerves, muscles, joints, and ligaments.

- The goal is to clear work of injuries and pain.
- Emphasis is on reducing cumulative trauma.
- The ergonomic approach benefits everyone.

Approach to Reducing Musculoskeletal Disorders

- **Written program** (The availability of a written and documented program can reduce MSD)
- **Employee involvement and training** (Training and participation of all employees will also reduce MSD)
- **Medical management** (Once a person has MSD, so he must look for medical aid, to go to occupational therapist)
- **Program evaluation** (This is important to find out, if the implemented approaches were efficient and effective or not).
Main Occupational Risk Factors

- Repetition/duration
- Joint deviation
- Force

Risk Factors for Upper Extremities

- Repetitive use of hand
- Use of hand force
- Use of pinch grip for holding
- Non-neutral wrist posture
- Elevation (rise) of upper arm
- Local mechanical pressure
Risk Factors for Upper Extremities

1. Flex
2. Flex
3. Spat
4. Melt
5. Stick
6. Hook
7. Hook
8. Fist Hook
9. Finger Hook

Pinch grip
Power grip
Poor
Improved
Risk Factors for Upper Extremities

Repetition/Duration

- 30 second rule: A job is repetitive if the basic cycle time is <30 second.
- Short duration: <1 hour/day
- Moderate duration: 1 – 2 hour/day
- Long duration: >2 hour/day
- The body is self-repairing.
Joint Deviation

- Ideally, joint deviation should be zero. (Different joints have different range of motion)
- Express in relative as well as absolute terms.
- Posture affects joint deviation, (which effects the internal force required to counteract the external force)
- Minimize torque about the joints.

Force

- Ideally, internal force on the joint should be low.
- The observed force = external force × moment arm.
- Reduce magnitude of external force, moment arm, and duration.
Vibration

- Interferes with blood flow.
- Causes mechanical trauma to body.
- Hand tool vibration increases grip forces.

Other Risk Factors

- Exposure to cold temperatures
- Trauma outside of work
- Anatomical or physiological imperfections
- Muscle tension from psychosocial factors
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**Solutions to Musculoskeletal Disorders**

- **Primary prevention:**
  - Prevent them from occurring
- **Secondary prevention:**
  - Stop them before symptoms appear
- **Tertiary prevention:**
  - Minimize consequences once symptoms have appeared

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**Identification of Problem Jobs**

- Records and statistics from medical and safety departments
- Operator discomfort
- Interviews with operators
- Expert opinion
Engineering Solutions (TOP)

- Analyze the job.
- Work to improve high-risk jobs first.
- Consider automation or mechanization.
- Consider job enlargement.
- Minimize joint deviation.
- Minimize force duration and amount.

Administrative Solutions (TOP)

- Job rotation
- Part-time workers
- Exercise
- Stress reduction
- Supports
Medical/Rehabilitation

- Physical therapy
- Medication
- Surgery
- Ergonomist should work on the ergonomic problem while medical personnel work on the person.

Hand/Wrist Problems

- In the tendons (e.g., tendonitis)
- In the neurovascular system (e.g., thoracic outlet syndrome, TOS)

TOS: It refers to nerve compression.
Thoracic outlet syndrome

Hand/Wrist Problems (cont.)

- In the tendons (e.g., tendonitis)
- In the nerves (e.g., carpal tunnel syndrome)
- Carpal tunnel syndrome: The median nerve through the wrist tunnel that carries tendons from the arm to the hand becomes pinched.
People with MPS I (mu-copolysaccharidosis) sometimes experience pain and loss of feeling in the fingertips as a result of carpal tunnel syndrome.

The wrist, or carpus, consists of eight small bones known as the carpals, which are joined by bands called ligaments.

A nerve called the median nerve passes through the space between the carpal bones and the ligaments in the wrists.
Carpal tunnel syndrome

How to Sit at A Computer
Risk Factors for Hand/Wrist Problems

- Internal force
- Repetitions
- Deviations
- Vibration
- Impacts

Engineering Solutions to Hand/Wrist Problems

- Repetition/duration: Reduce lifetime use of the joint.
- Joint deviation: Keep wrist in the neutral position.
- Force: Reduce force duration and amount.
Shoulder/Neck/Elbow Problems

- Rotator cuff tendonitis and others
- Tendon tears
- Bursitis
- Muscular shoulder pain
- Nerve-related disorder
- Neurovascular disorder

Engineering Solutions to Shoulder/Neck/Elbow Problems

- Repetition/duration: Minimize one-sided work.
- Joint deviation: Keep the upper arm vertical downward.
- Force: Reduce force duration and amount.

(TOP)
Back Problems

- Are extremely prevalent and costly (only colds cause more doctor visits than back pain).
- Include:
  - Low-back pain
  - Low-back impairment
  - Low-back disability
  - Low-back compensation

Risk Factors for Low-Back Pain

- Individual physical factors
- Psychological factors
- Task demand factors
- Environmental factors
Solutions to Low-Back Pain

Address three basic problems:
1. Underuse of the back
2. Whole-body vibration
3. Overuse of the back

Leg Problems

- Bursitis of the knee from kneeling
- Prepatellar bursitis from vibration while standing
Solutions to Leg Problems

- Reduce time spent on one’s knees
- Use knee pads or mats
(TOP)