Chapter 14

Musculoskeletal Disorders

Musculoskeletal Disorders

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

- The goal is to rid work of strain and pain.
- Emphasis is on reducing cumulative trauma.

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 of upper arm
- Local mechanical pressure

Repetition/Duration

- 30 s Rule: A job is repetitive if the basic cycle time is <30 s.
- Short duration: <1 h/day, Moderate duration: 1 – 2 hr/day. Long duration: >2 h/day
- The body is self-repairing.
- How many repetition per week or month is important.

Joint Deviation

- Ideally, joint deviation should be zero.
- Express in relative as well as absolute terms.
- Posture affects joint deviation.
- Minimize torque about the joints.

Force

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

Vibration

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

Other Risk Factors

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

Solutions

1. Prevent MSD from occurring
2. Arrest MSD before symptoms appear
3. Minimize consequences once symptoms have appeared

Identification of Problem Jobs

- Records and statistics from medical and safety departments
- Operator discomfort
- Interviews with operators
- Expert opinion

Engineering Solutions

- 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

- 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 nerves (e.g. carpal tunnel syndrome)
- In the neurovascular system (e.g. thoracic outlet syndrome)
- Carpal tunnel syndrome: The median nerve through the wrist tunnel that carries tendons from the arm to the hand becomes pinched.

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, calcific tendonitis, bicipital tendonitis
- 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.

Back Problems

- Are extremely prevalent and costly ($15 billion annually).
- Include:
  - Low-back pain
  - Low-back impairment
  - Low-back disability
  - Low-back compensation

Low-Back Pain Risk Factors

- Individual physical factors
- Psychological factors
- Task demand factors
- Environmental factors

Low-Back Pain Solutions

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:**
  - Reduce time on the knees
  - Use knee pads or mats