The Mechanisms of Musculoskeletal Injury

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**Purpose / Questions**

1. How does musculoskeletal injury really occur?
2. How can we use that knowledge to effectively reduce the risk of injury whilst maximising worker performance?
3. How can we get these results as easily and simply as possible?

**How does musculoskeletal injury really occur?**

- Injury occurs when load on tissue is greater than tissue capacity
- Tissues constantly adapt to the load placed upon them
  - Positively (improved capacity) and Negatively (Injury)
Types of musculoskeletal injury

**Acute Injury**

Sudden injury from a single event with:

- Very high exertion and/or speed
- Extreme postures
- Unexpected loads (e.g. fall)

**Cumulative Injury**

Chronic injury from prolonged exposure to:

- High exertion and/or speed
- Static and/or awkward postures
- Repetitive movements
- Environmental factors

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4 Physical (Internal) Injury Risk Factors

**Exertion**

Injury risk increases with:

- Higher effort (internal force)
- Higher speed movements (force - velocity)
- Eccentric contractions
- Smaller tissue size (CSA)

Resulting injury:

- Acute tissue damage
- Micro trauma leading to chronic injury
4 Physical (Internal) Injury Risk Factors

Exertion and internal muscle force

Exposure

Injury risk increases with:

- Tasks that involve loading for prolonged durations without recuperation periods
- Smaller tissue size

Resulting injury:

- Chronic overuse injuries if recovery periods are inadequate
4 Physical (Internal) Injury Risk Factors

Exposure (Duration vs Recuperation)

Tasks performed for prolonged durations without adequate periods of recuperation

Awkward Postures

Injury risk increases with:

- Tasks that require a ‘unnatural’ posture (force - length with exponential risk)
- Passive Range of Motion (ROM)
- Smaller tissue size

Resulting injury:

- Acute injuries if posture is extreme (end range)
- Cumulative injuries from tissue creep
4 Physical (Internal) Injury Risk Factors

Tissue creep from prolonged awkward postures

Movement Patterns

Injury risk increases with:

- Static postures - held for long durations
- Repetitive movements - shorter cycle times
- Smaller tissue size

Resulting injury:

- Chronic overuse injuries if recovery periods are inadequate, which lower tissue capacity
Environmental (External) Injury Risk Factors

- Heat / Cold
- Time Pressure
- Lack of Control
- Stress
- Cognitive:
  - Overload
  - Underload
- Pinch Points

- Vibration
  - Whole body
  - Peripheral

Vibration

Injury risk increases with increasing amplitude & frequency and resonance

- Whole body vibration
- Localised (hand / arm) vibration on smaller tissues

Resulting injury:

- Lower back pain (end plate damage)
- ‘White finger’ (vascular & neural damage)
Environmental (External) Injury Risk Factors

- Measuring whole body vibration - App

Mechanisms of musculoskeletal injury

- Exertion
- Repetition
- Awkward Posture
ErgoAnalyst - Calculating the risk of injury

- Exertion (force & speed)
- Exposure (duration vs recuperation)
- Posture (awkward)
- Movements (repetitive or static)
- Environment (heat, vibration, etc)

Risk Factors
ErgoAnalyst - Calculating the risk of injury

Reducing aches and pains caused by manual tasks.

+ + + = REDUCE EXERTION
             Lower force and speed
REDUCE ...                  Vary work tasks
               Work in comfortable postures
               Vary movement patterns

Reducing aches and pains caused by manual tasks.
**Answers**

1. How does musculoskeletal injury really occur?
   - Ans: Load > Tissue Capacity (exertion, exposure, posture, movement patterns)

2. How can we use this knowledge to effectively reduce the risk of injury whilst maximising performance of the workforce?
   - Ans: Design controls (↓ load &/or ↑ tissue capacity) via Participative Ergonomics

3. How can we do this as easily and simply as possible?
   - Ans: Systematic use of the 6 Step ErgoAnalyst system

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