Cumulative Trauma Disorders Among Cashiers

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Ergonomic Hazards for Cashiers

- Repetitive wrist motion
- Mismatch between hand coupling & object size
- Prolonged standing
- Bagging/lifting (Material handling)
- Awkward posture
- One hand scanning
Repetitive Wrist Motion

- Scanning items
  - Radial/ulnar deviation (out of alignment)
  - Hyperflexion/hyperpronation
  - Hypersuperinatation/hyperextension
Musculoskeletal Disorders Associated with Repetitive Wrist Motion

- Carpal tunnel syndrome
  - Compression of medial nerve
- Tendonitis
  - Inflammation of tendons due to overuse and repetition
- Ganglion cyst
  - Due to repetition
- Medial epicondylitis
  - Due to repetitive wrist flexion
- Lateral epicondylitis
  - Due to repetitive wrist extension
Mismatch between Hand Coupling & Object Size

- Pinch grasp vs. Power grasp
  - Pinch grasp – lead to muscle fatigue
  - Power grasp – full coupling

- Finger–thumb grasp
  - Example: pack of 6 soda
Mismatch between Hand Coupling & Object Size

- Objects > 5cm hand coupling:
  - require greater wrist velocity
  - greater acceleration of wrist motion
  - larger range of radial/ulnar deviation
Objects with 10cm hand coupling require more extreme flexion than objects with <10cm hand coupling.
Musculoskeletal Disorders Associated with Hand Coupling Mismatch

- DeQuervain’s tenosynovitis
  - Pinch grasp
  - Inflammation of tendon/synovial fluid on thumb

- Tendonitis
  - Inflammation of tendon due to extreme flexion/supination/pronation

- Carpal tunnel syndrome
  - Due to large range of radial/ulnar deviation
Prolonged Standing

- Fatigue
- Venous insufficiency
Bagging/Lifting (Material Handling)

- Torso twisting
- Torso compression
- Shoulder abduction
- Shoulder Shrugged
- Awkward posture
Musculoskeletal Disorder Associated with Bagging/Lifting

- Shoulder discomfort
- Lower back pain
Awkward Posture

- Any fixed or constrained body position that overload tendons, muscles, & joints.
Musculoskeletal Disorder Associated with Awkward Posture

- Tendonitis
- Myositis
One-Hand Scanning

- Increase wrist velocity/acceleration
- Increase radial/ulnar deviation
Musculoskeletal Disorders Associated with One-Hand Scanning

- Carpal tunnel syndrome
- Tendonitis
Cashier Check-stand Configuration

- Side configuration
  - Left-hand side configuration
  - Right-hand side configuration
- Front-facing configuration
- Over the end configuration
  - Customer far away
  - Not common
- European configuration
  - Cashier sitting
Side Configuration

Keypad is in front of cashier

Conveyor is on the left-hand side of the cashier

Shoulder abduction, body twisting
Conveyor is parallel to the cashier

Keypad is also parallel to the cashier
Example of Front Configuration

- Buddy system bagging
- Keypad is in front of cashier
- Conveyor parallels to the cashier
- Monitor not in front of cashier
Another Front Configuration

Keypad in front of cashier

Scanner parallel to cashier

Monitor not in front of cashier

Bagging area far away/
Buddy system not always available
Most Ergonomic Front Configuration

- Monitor in front of cashier
- Keypad integrate with monitor
- Scanner in front of cashier
- Conveyor parallel to cashier
Example of Left-Side Configuration

- Monitor in front of cashier or on the side of the cashier
- Conveyor on left side of cashier
Example of Right-Side Configuration

Monitor on the back of cashier

Conveyor on the right side of cashier
Visited 8 grocery/retail stores in South Bay

Document checkout stand configurations
  ◦ Observed the work behaviors of the cashiers
  ◦ Documented:
    • bagging behaviors
    • wrist motions
    • shoulder abductions
    • torso movements
# Research Summary

<table>
<thead>
<tr>
<th>Configuration</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scanner orientation</td>
<td>Horizontal</td>
<td>Horizontal</td>
<td>Horizontal</td>
<td>Horizontal</td>
<td>Horizontal</td>
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<tr>
<td>Monitor</td>
<td>Not in front of cashiers</td>
<td>Not in front of cashiers</td>
<td><strong>In front of cashiers</strong></td>
<td>Not in front of cashiers</td>
<td>Not in front of cashier</td>
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<tr>
<td>Keyboard</td>
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<td>Not in front of cashier</td>
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<td>Not in front of cashiers</td>
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<tr>
<td>Checkout Stand</td>
<td>Side configuration (left)</td>
<td>Side configuration (right)</td>
<td><strong>Front configuration</strong></td>
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## Research Summary

<table>
<thead>
<tr>
<th>Work Posture</th>
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<th>G</th>
<th>H</th>
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</thead>
<tbody>
<tr>
<td><strong>Wrist motion</strong></td>
<td>Repetitive, accelerate in supination/pronation plane,</td>
<td>Repetitive, accelerate in supination/pronation plane</td>
<td>Repetitive, accelerate in supination/pronation plane</td>
<td>Repetitive, accelerate in supination/pronation, radial/ulnar flexion/extension plane</td>
<td>Repetitive, accelerate in supination/pronation plane</td>
<td>Repetitive, accelerate in supination/pronation, radial/ulnar hyper-flexion</td>
<td>Repetitive, accelerate in ulnar/radial, supination/pronation plane</td>
<td>Repetitive, accelerate in supination/pronation plane</td>
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<tr>
<td><strong>Scanner gun use</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<td>No</td>
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<tr>
<td><strong>Standing or sitting</strong></td>
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<tr>
<td><strong>Twisting torso while bagging/grasping scanner gun</strong></td>
<td>Twist torso while bagging, twist torso for grasping scanner gun</td>
<td>Twist torso while bagging, twist torso for grasping scanner gun</td>
<td>Twist torso while bagging</td>
<td>Twist torso while bagging</td>
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<td>Twist torso while bagging</td>
<td>Twist torso while bagging</td>
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<table>
<thead>
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<th>Material handling techniques</th>
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<th>E</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td><strong>Type of grip</strong></td>
<td>Pinch/power</td>
<td>Pinch/finger-thumb/power</td>
<td>Pinch/power</td>
<td>Pinch/finger-thumb/power</td>
<td>Pinch, finger-thumb</td>
<td>Pinch/power</td>
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</tbody>
</table>


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<tr>
<th></th>
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<th>F</th>
<th>G</th>
<th>H</th>
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<tbody>
<tr>
<td>Lifting</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
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<td>Yes</td>
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<td>Shoulder abductions</td>
<td>Mildly</td>
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<td>Mildly</td>
<td>Mildly</td>
<td>Mildly</td>
<td>Very slightly</td>
<td>Mildly</td>
<td>Large angle abduction</td>
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<tr>
<td>Location of bagging area</td>
<td></td>
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<td></td>
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<tr>
<td>Close or far away from body</td>
<td>Close to body</td>
<td>Close to body</td>
<td>Close to body</td>
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<td>Close to body</td>
<td>Close to body</td>
<td>Close to body</td>
<td>Far away from body</td>
</tr>
<tr>
<td>Left/right/front/behind</td>
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<td>Right/behind</td>
<td>Straight behind</td>
<td>Straight behind</td>
<td>Straight behind</td>
<td>Straight behind</td>
<td>Right/behind</td>
<td>Left/behind</td>
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<tr>
<td>Teamwork for bagging</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<td>No</td>
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<tr>
<td>Number of lanes open</td>
<td>6</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>6</td>
<td>4</td>
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</tbody>
</table>
Research Summary

- Store C has the best ergonomic design checkout station
- Cashiers in Store A & B practiced least wrist motion due to scanner guns use
- Cashiers in Store H used most pinch grasp
Store H also has the worst location in terms of bagging area
Research Summary

- Store B & F have the best ergonomic administrative control
- Most lane opened
- Store F also has buddy system in bagging groceries
Ergonomic Intervention

- Engineering control
- Administrative control
- Education/training
Engineering Control

- Design of checkout station
  - Front configuration/front monitor
    - minimize body/torso twisting
  - Gun scanner
    - Minimize wrist motion/repetition
  - Bagging location close to body
    - Minimize shoulder abduction
  - Accommodate 5th & 95th percentile
    - By collecting anthropometric data
Engineering Control

- Flooring
  - Terrain flooring to minimize pressure on ankle
  - Provide thicker anti-fatigue mat to release pressure
Grocery objects handle resizing
  ◦ Redesign objects’ handles
    • Minimize pinch grasp & maximize power grasp for full coupling
Administrative Control

- Frequent rest break
- Buddy system
  - Bagging
  - Minimize body twisting/lifting
- Provide sit/stand stool
  - Alternate body posture
Education/Training

- Employee ergonomic training
  - Proper posture
  - Alternate posture

- Exercise program
  - Muscle training

- Employee participation in ergonomic design/training
  - Hazards identification


Any Questions ?